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THE LONDON NATURALIST

the Journal of the
LONDON NATURAL HISTORY SOCIETY

EUROPEAN CONSERVATION YEAR

1970

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THE LONDON NATURAL HISTORY SOCIETY

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LEONARD PARMENTER

(1903 – 1969)

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Editorial

ALTHOUGH this issue of the *London Naturalist* records the activities of our Society in 1969, it appears in European Conservation Year, 1970. It is for this reason that the E.C.Y. symbol appears on the cover, and that some passing comment is appropriate here.

By the time this journal is published, the Strasbourg Conference will have receded into the past, European Conservation Year itself will have run more than half its course, and the problems of environment will have have been explained and debated in broadcasts, books, newspapers and magazines, and at a multitude of meetings throughout Britain and abroad. For London, indeed, the process began on December 16, 1969 at the Dinner given by the Corporation of London to launch European Conservation Year in this country; since then, in the words of His Royal Highness the Duke of Edinburgh, speaking in the Guildhall that evening: "we are in changing times, as we are tirelessly reminded, and one of the charges is that today the words conservation and environment are bandied about like tennis balls at Wimbledon". Some, indeed, have expressed the fear that we shall tire of the words before we understand their meaning.

There are many aspects of conservation, and their sum is the concern for the overall environment; it would be invidious to select any one as being more important than the others. Nonetheless, one particular aspect, nature conservation, is, and has long been, the particular concern of our Society.

In the Greater London area wildlife exists by virtue of two facts: its ability to adapt to a changing environment on the one hand, and the extent to which remnants of semi-natural habitats survive in our parks, commons and open spaces on the other. The London Natural History Society is composed of people, living or working in London, who are interested in Natural History; since its formation in 1858 it has seen the metropolis expand from under three million persons to over seven million in 1969. With this growth in numbers has come the expansion of the built-up area and the consequent disappearance of the rural environs which harboured an abundance of plant and animal life and were well known to the earlier members of the Society. Today housing estates, in some cases already facing demolition, stand on the site of fields which, in the early years of this century, provided hay for London's horses, and it requires a vivid imagination indeed to envisage the scene described by a poet of 1902:

> "Hendon and further out afield,
> Low water-meadows are his ken;
> And lonely pools by Harrow Weald,
> And solitudes unloved of men".

In these circumstances, it is hardly surprising that the Society showed an early interest in conservation. The history of this particular aspect of our activities has been admirably documented by C. P. Castell in his papers, *Nature Conservation in the London Area* (Castell, 1947) and *Post-War Progress in Nature Conservation in the London Area* (Castell, 1954); the significance of his own personal role in this, as in so many other facets of the Society's work, can never be sufficiently stressed. In more recent years, the reports of the London Nature Conservation Committee reflect the Society's continuing concern and vigilance, whilst the extensive programme of special lectures and meetings for 1970 itself records this Committee's enthusiasm and effort. A full report on these activities will, of course, have to wait until 1971.

The formation of the various County Trusts for Nature Conservation bordering on our Society's area has in many ways eased the burden. Whilst the London Natural History Society includes the promotion of nature conservation amongst its aims, for the Trusts it is their prime function and one of their most important contributions has been the establishment and management of nature reserves in our Society's area. Like the L.N.H.S., however, they are concerned also with records, since without a foundation of knowledge there can be no secure building of management practice.

Thus, although the Trusts and our own Society overlap in interest and function, they are essentially complementary, and anything which weakens one weakens the other. As today conservation becomes increasingly complex, drawing on a wide range of skills and experience, voluntary bodies and local authorities are being drawn together in the planning process, so that organisations such as our own are more and more being asked for advice and comment. Wildlife is an integral part of our environment, and the participation we are now offered in its planning is a responsibility the early members of the Society would have envied.

Again, this year, pressure of papers have exceeded space available, with the result that, regretably, Part VII of Eric Groves' *Hemiptera-Heteroptera of the London Area* will appear in the *London Naturalist* No. 50. This year, however, we publish three papers held over from the past: *Flowers and Figures*, by Miss E. M. Hillman, *London's Lichens*, by J. Laundon, and *Some Recent Temporary Exposures of London Clay in the London Area*, by Adrian J. Rundle and John Cooper.

REFERENCES

CASTELL, C. P., 1947. Nature Conservation in the London Area. *Lond. Nat.*, 26, 17-41.

———, 1954. Post-War Progress in Nature Conservation in the London Area. *Lond. Nat.*, 33, 6-20.

Looking into the Past

By R. E. Butler

(*Presidential address delivered on October 9th 1969*)

THE past has a potent appeal to most minds. Because of this, I am inviting you as naturalists, to take a look at a few aspects of it.

We may consider the past in two parts, the longer part covers that enormous period of time which takes one back to the beginning, and brings one to within a million years or so of the Present Day. One may regard this as the field of the geologist, but even he is unable to trace earth history right back to the very beginning. The second and shorter part may be considered as dating from the arrival of man, himself a product of the story of evolution, but seemingly bent upon changing so much, and destroying so much of his natural environment. In this part the geologist is still deeply concerned, but the archaeologist also takes a hand and plays a dominant role.

How long life has existed on this planet of ours no one really knows. If we consider the earth to be 5,000 million years old then perhaps life has existed for half this time in some form or another. There are some people who think that life may be as old as the earth itself—possibly was there in the original primeval matter. The recent discovery of formaldehyde in the galaxy could point to this. One thing is certain, and that is that man has not been around for very long—possibly for only 1¾ million years. It was once suggested that if we represent the age of the earth by means of a clock, then man would have arrived at one minute before midnight.

In looking into the past, recollections, images and interests are special to every individual. We, all of us, tend to wear blinkers and restrict the width of our interests, and so miss much which is concerned with the very field we are studying. To the farmers and gardeners, the success or failure of the current results of their labours in controlling Nature, depends on the past of a few months ago. To the leaders of field meetings in demonstrating Living Nature, "yesterday" could be as much the past as is last Spring or last year. To the archaeologist and the geologist the past is much more static, and has to be organised on to an historical type of basis.

We certainly have better ideas today, compared with when Bishop Ussher made his notorious statement that the Earth was created in the year 4004 B.C. It was even suggested that fossils had been deliberately put into the rocks at the time of the Creation in order to confuse man.

Fossil collecting goes back more than 3,000 years. Famous Greeks such as Hippocrates and Aristotle were interested in them. In round barrows on Dunstable Down there have been found remains of people dating back to the Beaker cultures of the Bronze Age. They had been buried with specimens of fossil sea urchins. For many years fossils were usually associated with the Great Flood of biblical times. Theories postulated that fossils had important scientific significance were found difficult to accept.

Among the many pursuits that the remarkable man Leonardo da Vinci followed, was canal building. He came upon fossils when engaged upon the construction of a canal across Northern Italy. He was convinced of marine submergence as the explanation for the beds containing fossils. It was, however, left to another canal builder in England, William Smith, living three hundred years after Leonardo da Vinci, to really pioneer the work of examining the natural history of the past. Smith made a great study of fossils and used them to interpret geology. Smith is often referred to as the "Father of English Geology". His collections are preserved in the Natural History Museum at South Kensington. The year 1969 is of some significance as it is the bicentenary of his birth.

However, it is not my intention to give details of the work and records of fossil collectors and naturalists of the past. Written accounts put down as events were taking place can only take us back a certain distance in time. I wonder how many naturalists looking into the past would turn to the translations of the Anglo-Saxon Chronicles. These contain entries relating to natural events. One entry dated 1087 could perhaps be one of the first records of nature conservation is this country. It reads:—
"He planted a great preserve for deer, and he laid down laws therewith, that whosever should slay hart or hind should be blinded. He forbade the harts and also the boars to be killed. As greatly did he love the tall deer as if he were their father. He also ordained concerning the hares, that they should go free. His great men bewailed it, and the poor men murmured thereat; but he was so obdurate, that he recked not of the hatred of them all; but they must wholly follow the king's will, if they should live, or have land, or property, or even his peace." The reference is of course to King William II and to the New Forest. The word "deer" may be "deor" meaning beasts in general (this is an observation made by the translators).

I must not fail to mention the Roman writer and historian, the younger Pliny, who has left us an eye witness account of the eruption of Vesuvius on August 24th 79 A.D. This eruption was the one which buried Pompeii and Herculaneum. Pliny's account is so detailed, that any volcanic eruption today that approximates in character to it, i.e. a stupendous blast of uprushing gas which rises to several miles and then spreads out into an expanding globular cloud, is called a Plinian type of eruption.

Pliny only takes us back to Roman times. Of such times we have ample evidence, and can build up from it a more or less complete picture of what life was like during those times. All over our country are magnificent remains of Roman cities, villas and farms; some provide us with evidence of the natural history as well. The Roman palace at Fishbourne, near Chichester, had a fine garden, and evidence of the plants which grew in that garden is to be seen from decorative drawings on wall plaster that have been recovered from the site. Evidence has also been uncovered there, which provides a clear picture as to how the nearby coastline has altered. Even ballast used by the Roman ships has been discovered, this consisted partly of granite brought from the Channel Islands. The archaeologist and geomorphologist must be relied upon a lot to take us back into prehistoric times before the Romans. Frequently Archaeology has been rejected as a subject having much to do with natural history. Earlier there may have been some truth in this up to a point, but modern archaeological techniques certainly have very close links with natural history.

The biggest archaeological monument in Europe, Silbury Hill, has recently been re-excavated. A full report is awaited. I wonder how many people have said "Well what did they expect to find"—I have heard this said on more than one occasion. Professor Atkinson, who directed the excavations, stated during one of the last programmes presented by BBC Television on the dig, that the archaeologist may by past experience have a "hunch" as to what is likely to be there, but he does not expect to find any particular thing. He deals with whatsoever he finds. Silbury produced no skeleton but a wealth of remains of insects, molluscs and plants. Radio carbon dating enables us to know how many thousands of years ago these creatures lived. At Silbury it has been possible to examine the former land surface covered up by man four thousand years ago. Pollen analysis indicates mainly grassland weeds; the presence of the remains of beetles and winged ants suggests the months of July and August when the old land surface was first covered, but the presence of winged queen ants narrows this down to the month of August.

From evidence obtained from numerous sites we have considerable information on the plants used by Palaeolithic man. One of our earliest pieces of evidence of vegetable foods is to be found in the carbonised hazel nuts discovered in the Farnham Pit dwellings. The Glastonbury lake dwellers were known to have made great use of wild plants—sloe and blackberry for food—moss for plugging cracks in their timber buildings—ferns and bracken for bedding—hair moss and osiers for basketry—certain fungi were used for tinder, whilst caraway and poppy seeds were used as delicacies. We also know that certain succulent grubs and snails were appreciated. We find much evidence of the natural history of the past in peat deposits. After the withdrawal of the ice sheets at the end of the Ice Age, much of the soil had been removed from the higher areas, whilst on the lower lying areas glacial debris had been left as moraine and boulder clay, awaiting recolonisation by plants. Numerous lakes left by the glaciers filled up and became swamps. Southern England was probably at a slightly higher level then, than today, and became covered with swampy forest and peat bogs. Much of the floor of the North Sea is submerged forest. The peat and submerged forest contain much evidence of the past, particularly in the pollen grains which became fossilised. The pollen grains can be identified, whilst radio carbon present enables us to date them. The ice probably retreated for the last time about 8,300 B.C., and we passed from a glacial into a pre-boreal climate (cold and dry but becoming warmer) with birch as the dominant tree. By 6,000 B.C. having passed through a warm dry period, the country was enjoying an Atlantic type of climate (warm and wet) with alder, oak, hazel and elm trees growing successfully. By 3,000 B.C. the Mesolithic period had passed into the Neolithic, and the climate became sub-boreal (cooler and drier) with alder, oak, lime and ash. Climatic conditions continued to change through the Bronze Age and the Iron Age. By 500 A.D.—well into what are usually regarded as historical times the Atlantic type of climate had returned.

The present day levels of the peat are used as arguments in proving that the British Isles are tilting—unfortunately this is not in favour of London. Nine sites in Britain, and two in Holland have been investigated, and it is shown that there has been a subsidence of East Anglia and Kent by 6 metres during the last 6,500 years. The temple of Mithras, discovered in 1953-54 on the Walbrook site, was well below present high water mark. Roman pottery discovered in Southwark was at levels 1·5 and 2 metres below present high water. The fact that the Thames is tidal today as far as

Teddington, whereas in Roman times it was less affected by tides, adds weight to the subsidence ideas.

Going back into Glacial times, we are really getting back to the early days of man—a million years into the past saw the first ice sheets arrive. Much of Britain was icebound and south of the ice margins the vegetation was certainly of tundra type. However, the ice made several advances and retreats, and there were periods of better times—Interglacial periods. The story of one such interglacial period is preserved in the famous Hoxne lake deposits near Diss. At this locality there was a lake, and in its deposits are preserved the remains of animals and plants—of special interest are the fossil pollen grains. Going from the botton layers to the top of these deposits one can, with the aid of the pollen, trace a gradual warming up of the climate from the very cold arctic type to conditions which were certainly much warmer than our present day conditions. Then the reverse occurred and the climate cooled off again so in the uppermost layers the plants are back to those typical of an arctic type such as arctic birch. Much evidence concerning interglacial conditions was unearthed in London during 1957. During excavations for the foundations of the Uganda Government buildings in Trafalgar Square, a wealth of material was found. Dr. A. J. Sutcliffe and others of the Natural History Museum investigated this material. Remains of animals included hippopotamus, the now extinct straight tusked elephant; rhinoceras, wild ox, red deer, fallow deer and lion. Over 1,300 specimens of land and river molluscs representing some 60 species were recovered. Among them was the pearl bearing mussel and a tiny snail neither of which live today in Britain but inhabit areas of Southern Europe. These molluscs not only provide information on the climate of the past, but tell us quite a lot about the River Thames in those days. Numerous insect remains were discovered, along with many plants. Some of the plants such as the South European maple are certainly not native to this country today.

I have made several references to radio carbon used for dating purposes. This, and other similar radioactive substances have become very important. Nitrogen is an element whose atom normally has a mass of 14. Natural radiations convert some of the nitrogen atoms in the air into carbon atoms of the same mass. Carbon atoms normally have a mass of 12. The ratio of Carbon 14 to Carbon 12 appears to be fairly constant, and both types of carbon atoms are absorbed by plants during photosynthesis, so in the living plants this constant ratio between the carbon atoms is unchanged. With the death of the plant, absorption of carbon ceases, and the carbon 14 is not replaced to preserve the ratio. C14 slowly decays. Now, we know that radioactive changes go on at speeds which are completely unaffected by external conditions and that half of the original carbon 14 will have decayed in 5,568 years (the half life value). Three quarters will have gone after 11,140 years. Hence it is quite easy to date a piece of carbonised wood from its carbon 14 content. This radio carbon method is surprisingly accurate—the classic test for this was on a piece of wood from Qumran (A Dead Sea scroll locality)—this wood was known to date from about 68 A.D.—the radio carbon dating gave an age of 1,940 years. Carbon dating suggests that Stonehenge was constructed in 1860-1560 B.C., the first phase of Avebury about 1700 B.C., and the extant barrow of Wayland Smithy was made in 2820 B.C.

The geologist however, cannot go back very far with radio carbon, but he has other similar methods. Many minerals in the rocks contain the metal Potassium, the atom of which normally has a mass of 39 but there are some atoms of mass 40. These slowly decay into the inert gaseous element Argon which becomes trapped within the mineral crystals. The half life of Potassium 40 is 1,300 million years and so by examining the amount of Argon present one can deduce how much of the potassium has decayed. The element Uranium likewise decays very slowly and in a million years 1 gm of uranium will produce 1/7000 gm of lead—hence uranium/lead ratios in minerals may also be used for dating purposes. Such tests have been carried out on the ancient rocks of Scotland, and ages ranging from 740 million to 885 million years have been determined. No doubt the rocks from the Moon brought back by the Apollo missions have also been put to these tests.

I will now return to fossils, which are one of our greatest assets for helping us to build up a picture of the past. A very large number of people become interested in geology simply because of fossils. Many youngsters collect fossils, and if they continue to do so into adult life, there is a good chance of their becoming fully fledged geologists. However there is much more to fossils than building up a massive collection. The scientific importance of fossils may be summarised as follows:—

(i) They are the remains of prehistoric life, and often it is possible to build up a reconstruction of what the creature or plant actually looked like when living.

(ii) They provide important information on evolution.

(iii) They provide information about the rocks in which they are found, i.e. whether the sediment which formed the rock was laid down in shallow water or in deep water, in rivers, swamps or even in deserts.

(iv) They provide information on the geography and ecology of the past. We know from fossil evidence that Alaska and Siberia were once joined—also Australia and Malaya—the separation of the latter may have been earlier than the former.

(v) The distribution of shallow water molluscs help us to trace ancient shorelines.

(vi) Fossils provide information about past climates. Both the Silurian and Jurassic periods in British geology are rich in corals, and so in those times warm shallow seas must have covered parts of the British Isles—corals generally need warm water. Fossil plants found in Greenland and Antarctica prove that these areas once enjoyed very warm climates.

(vii) Certain fossils of limited time distribution are useful in correlating strata from one district to another.

(viii) Some fossils are of economic value. Coal is mainly fossil material.

Above all the geologist uses fossils to fix geological time (the fourth dimension of the earth's past). The first rocks which contain abundant fossils are those of the Cambrian period reckoned to begin about 600 million years ago. This period starts off the great Palaeozoie era which lasted 375 million years. Major biological changes are taken by the geologist for fixing the beginnings and endings to the great geological eras. Large scale extinctions of many groups of animals and the arrivals of many new types provide the deciding factors. The trilobites and many groups of the brachiopods vanished to mark the end of the Palaeozoic, whilst the arrival of the true ammonites and newer types of brachiopods marked the start of the second great era, the Mesozoic. This era saw the ascendency of the reptiles culminating in the well known group called the dinosaurs. The Mesozoic lasted for 155 million years, and then again occurred massive extinctions. The ammonites which had undergone rapid and often peculiar evolutionary changes just vanished. The dinosaurs which had roamed the Earch also vanished. The extinctions of great animal groups provides us with difficult biological problems which have never really been solved. As regards the dinosaurs, it has been suggested that large scale vegetation changes at the end of the Mesozoic may have killed off the herbiferous dinosaurs, and this in turn killed off the carnivorous ones that lived on them. This suggestion does not find much favour because in the Upper Cretaceous it would appear that some dinosaurs were flourishing quite well on the newer types of vegetation. There is also the question of the heat control of their bodies—they had no protective covering to retain heat like birds and mammals. At the end of the Mesozoic, the climate became cooler and the dinosaurs could not cope. However, these creatures died out even in the warmer parts of the world. Some people have suggested that their great size indicated possibly an overactive pituitary gland but I must mention that not all dinosaurs were enormous and the small ones also became extinct. With the general decline in the reptiles, mammals and birds became important, and into the next great era the Caenozoic or Tertiary, the animals and plants are assuming the characters of present day forms. Man's arrival some 1¾ million years ago is the last great biological time fixing event. Animal extinctions however continue, as for example with the Irish elk. The geologist does not rely entirely on fossils. One must appreciate that some rocks are without fossils and so other features must be looked for. Ripple marking can be fossilised; this occurs in shallow water, and can occur in deserts, but if one looks closer at the rock, if it is a sandstone, one can tell from the sand grains themselves whether they were deposited in a desert or under water. Desert sands show heavy attrition effects—they are often called millet seed sands. Rain prints and suncracks can be fossilised into the rocks—these would indicate possible mudflat conditions at the time of deposition. Elementary chemistry can be brought into the methods of delving into the past. During the Triassic peroid which opened the Mesozoic era, Britain was suffering rigorous conditions of a hot desert. Typical desert sands from that period were laid down as the Bunter sandstones of the Midlands—ironically these sandstones provide us with the best water bearing strata that we have in this country today. At times these deserts had areas of water. As these lakes dried up the waters deposited numerous minerals, among them calcium sulphate. Now calcium sulphate will crystallise as the hydrated salt forming gypsum under normal conditions, but if the water is fairly warm then the anhydrous salt will crystallise as anhydrite. In some places where these lakes existed we do in fact find deposits of anhydrite indicating a very warm temperature for the water.

From Neolithic times and possibly earlier, ancient man must have unwittingly helped in the spread of plants. The principal roads and tracks were chosen so that they followed the higher well drained ground i.e. the limestone and chalk outcrops such as the Jurassic scarp which runs from Yorkshire to the Cotswolds; the Harroway along the Chalk from Kent to Stonehenge and beyond; and the Icknield Way/Ridgeway route from the Wash to the Berkshire Downs, Marlborough Downs and beyond. In the clay vales away from these ridges, were dense oakwoods inhabited by such animals as the wolf, the bear and the lynx. These routes were lines of trade and must have greatly assisted in the spread of wild plants. Many of our common wild plants, it is agreed, have had a southern European origin and were probably introduced accidentally by the Celts and the Romans. Rightly or wrongly the Romans are credited with the accidental introduction of the pimpernell and the poppy, together with others such as fool's parsley and the small stinging nettle. It is certain that they deliberately introduced the gardener's curse,—the ground elder, which was prized as a medicinal herb. They also introduced hemlock and henbane, the latter valued for its narcotic properties.

Sir Edward Salisbury has pointed out that Roman roads with sloping sides to their embankments would have been eminently suitable for colonisation by plants, as have our own railway embankments.

To study the present in any field of natural history may seem a full enough task, but it remains incomplete without some knowledge of evolution. Here, museum collections of fossil plants, birds, mollusca and other animals are invaluable: it is in Geology that we find the beginning and interdependance of all aspects of natural history, and the results of changes of climate or conditions are convincingly demonstrated.

We examine moon rock; and map the geology of the ocean floors. From an aeroplane we are at times able to see much more of the geological structure, and certainly a lot of archaeological evidence. As seen from the ground alone, the study of man through the ages, shows what a destructive animal he is of the natural history surrounding him.

Report of the Society for 1969

COMPARED with the figures quoted in the Report for 1968, the present membership in all classes, 1,202, seems to show an alarming drop of 527. Some loss of membership was expected arising from the necessity to review the subscription structure. This year has, in addition, seen the completion of a critical and prolonged examination of the membership records by the Membership Secretary. Such a review is essential from time to time but is an exacting task not lightly to be undertaken. As a result, however, it may be fairly claimed that the figure quoted, 1,202 made up as to:—

Ordinary members	974
Affiliated members	23
Family members	82
Junior members	85
Honorary members	18
Life members	20
	1,202

represents the membership of the Society as at October 31, 1969.

The death is announced with regret of the following members during the year: Mrs. P. Bates, W. J. Kaye (the Society's longest serving member), Miss K. Marks, Miss L. Mathieson (the Society's second-longest serving member), H. Greenfield, H. G. Denvil and L. Parmenter, a former President.

So far as the Society's administration is concerned, the year has been an exacting one, illness causing a serious gap for some months, but further expert assistance has now been embodied into the Secretariat and some of the accumulated work has been disposed of.

Undoubtedly the most important task was the disposition of so much of the Hindson Bequest as has as yet been paid to the Society, a sum at October 31 amounting to £14,000. From the outset this bequest has been regarded as a capital asset and none of the monies available has been diverted to revenue accounts. The settlement of the bequest has not yet been completed, but in the meantime arrangements have been made with the Westminster Bank Trustee Department for the investment of £10,000.

At Bookham Common, the soil analysis survey which suffered a serious set-back when illness overtook Mr. C. P. Castell has now been resumed under the Directorship of Mr. H. A. Sandford. A successful application has been made to the Carnegie Trustees for a grant towards the cost of this scheme. The Director is in urgent need of further assistance and will welcome workers able to help him and his team in this investigation.

As reported last year, 1970 is to be European Conservation Year and your Council arranged to sponsor a special programme of activities in this connection. Mrs. L. M. P. Small has organised this with co-operation from the sectional officers and a very full and varied programme awaits us.

During the year, the officers of the Archaeology Section ran into difficulties, finding themselves unable to fill gaps following resignations among their number, but a happy solution was found in the amalgamation of the section with the Geologists. The new joint section was formally inaugurated on November 19, 1969 and we can look forward to a healthy programme embodying activities of interest to adherents of both disciplines.

The Archaeology Section listing some interesting meetings, report with regret that none of them was well-attended.

Work has continued during the year on the pottery found at Borough High Street. The work on post-medieval pottery having been completed expert assistance is being obtained for the Roman material.

Thursday evenings, the Chairman leads work on the masses of pottery found this summer in Montague Close, Southwark and any members interested in pottery are invited to join.

In view of poor attendances and the difficulty of finding officers, this Section asked the Geology Section to consider an amalgamation, and the respective Committees having formally proposed such action, the Council on September 18, 1969 approved the amalgamation of the two Sections.

The Botanists are pleased with an increase to 37 in their average attendance at the three sectional meetings: an improvement on the figures for last year.

A useful fact emerges from their report that informal meetings, always well attended, seem attractive to new members.

Of the wide range of field meetings, the Whitsun Weekend held at Lyndhurst in the New Forest attended by 24 members was "happy and profitable". The Section record their thanks to Mrs. Yule for her expert guidance and making freely available her knowledge of the Hampshire flora.

The Ecologists have averaged an attendance of 34 at their three indoor meetings. Joint outdoor meetings have been held with the Herts./Middlesex Naturalists' Trust and with the Entomological Section. They already have in mind their contribution to European Conservation Year 1970 as a Nature Trail at Bookham Common.

Their report stresses that all records are important, and they ask all members of the Society to assist by sending records (mammals, fish, molluscs, reptiles and amphibians) to the appropriate addresses.

The Entomologists held nine indoor meetings, but with the exception of a joint meeting with the British Arachnological Society which attracted an audience of over 60, of whom about half were Society members, in the main attendances were poor. It is hoped to arrange further joint meetings. A joint visit to Farthing Down with the Ramblers was well received but the same success did not attend a joint meeting with the Ecologists.

Whilst the response to the Ladybird survey has not been as great as had been hoped, accent has now been placed on two of the commonest species (the 2- and the 7-spot ladybirds) and Society members are asked to assist in this survey.

The Epping Forest Field Section strike a new note in their annual report by complaining of the lack of mud which is likely to cost them their reputation for rough and heavy walking. Neither of the fungus meetings was very successful because the specimens were undersized and dried up, but experience reveals that the August meeting is the more popular and successful of the two.

Showing an increase over previous years, the average attendance at field meetings was 13.

The Geology Section reports a varied and interesting year. The talks included one on agates with a distribution of samples. Successful field trips were led by members of the section: the highlight of the year probably being the Easter field meeting on the Isle of Wight during which there were one or two notable finds including the vertebra of an iguanodon. Two members of the section made the remarkable find of a fossil turtle skull at Abbey Wood, possibly the oldest complete turtle skull in Europe.

The Ornithology Section held 9 formal indoor meetings with an average attendance of 90 to 100 members including, at one of the best attended meetings, a stimulating progress report on the Atlas Project. A joint meeting with the B.T.O. was arranged, followed by a buffet supper, the address being given by the President of the Cambridge Bird Club.

The most successful meeting of the year attended by 300 people, was that held jointly with the R.S.P.B. at Caxton Hall on November 4, at which Bobby Tulloch gave an excellent talk, superbly illustrated about the Birds of the Shetland Islands. Eight informal meetings were held monthly through the winter, covering a variety of subjects and which were consistently well attended by an average of 40 members.

The Section's Annual Dinner was held in March, Mr. S. Cramp being the guest of honour who gave a most excellent talk on his expedition to Libya.

A very successful programme of field meetings was arranged and these consisted of six weekend outings, 13 day coach trips and 41 whole or half day meetings. In addition, two weekends were specially arranged for junior members. Three of the weekends were based on Cley in Norfolk, one on Southwold, one on Weston-super-Mare and one on Dumfries.

All were successful from an ornithological point of view, particularly the weekend on the Solway. So far as whole or half day meetings were concerned, these were well attended and in many instances numbers of over 40 were present.

Coach outings, which last year proved very popular and were usually over-subscribed, seem not to have been so popular this year. Coach outings to new venues are being arranged this year but rising costs necessitate watching the position of this activity.

Three enquiries have been organised, covering the Black Redstart, gull flight-lines and the Atlas Project, which has again been the main research project for the year.

The possible hazards of bird-strikes to jet aircraft are causing increasing concern as the air space around the major airports becomes more congested. The subject has assumed added importance recently in view of the enquiries into the siting of a new airport. One of the ways in which it was felt that the Section could provide some useful information towards the study of this problem was by recording the movement of gulls across the approach routes to London airport to and from their roosts on the reservoirs.

A remark applicable to all sections is made in the report of the Research Committee, "The success of our research projects depends very much on the help given by members".

Behind a very modest report, the Ramblers hide what has obviously been an interesting year. Not surprisingly, since the subjects range from Thailand to the Bass Straits, the average of attendance at the indoor meetings remained constant with last year at 30. A wide variety of outdoor meetings attracted a smaller average and varied from a cruise through the London Docks, to a visit to the Victoria and Albert Museum to see tapestries.

The South West Middlesex Section have averaged 19 members at indoor meetings. Like the Ramblers, this Section has wandered far outside the Society's area with lectures dealing with the birds and flowers of Austria and the botany of the Pyrenees. At outdoor meetings the numbers attending ranged between 3 and 30.

Despite an increased subscription, the Section retains its membership of the Hounslow Council for the Arts.

The Hindson Bequest

Members will be aware of the substantial bequest made to the Society by the late Mr. M. T. Hindson. The final total of the bequest is still uncertain as further instalments are anticipated.

It is Council's intention that this money should be used for the lasting benefit of the Society, and considers that this will be best achieved by giving first priority to the acquisition of premises to serve as a permanent centre for the Society and its library.

It may take some time to find premises suitable to our needs. In the meantime members will be kept informed of the progress made.

R. E. Butler,
President.

Botanical Records for 1969

Compiled by J. Edward Lousley

FOLLOWING several years with unfavourable summers, 1969 gave the botanists little cause for complaint. After a wet May, and cold spell in early June, the summer and autumn were dry and warm. The rainfall for the year at St. James's was only 21·01 inches, 90% of the average, but there was no serious drought and few ponds fell to very low levels. This was due to the absence of excessive heat and the soaking early in the year.

The number of records contributed was about the same and of considerable interest, but there was no outstanding new discovery. The most valuable features were the records from several members of the persistence of salt-marsh species in north Kent where the habitats by the Thames are changing rapidly, and the additions to our records for Hertfordshire and N. Essex.

In this report "Tetrad" references, as used in the Mapping Scheme, are cited where available, and failing this 10-kilometer squares of the National Grid. In both cases these appear in brackets following the place names. The nomenclature is based on the *List of British Vascular Plants* (1958) prepared by J. E. Dandy, and for species in that *List* authors' names are omitted to save space.

V.-c. 16, West Kent

From a small bit of chalk down above Longfield Station (66/T08), P. C. Hall reports *Filipendula vulgaris*, Dropwort. This is less than a mile from Pinden Farm, and may be the same locality as reported by Cooper in 1837. We have only one previous record for this species as found by our members in the part of our Area in Kent. On the same down there were trees of *Sorbus torminalis*.

R. M. Burton sent a useful list from the eastern part of the Arsenal ground at Woolwich, now being developed as Thamesmead, and from Crossness (51/48). Near the latter he found *Rumex palustris* and F. J. Holroyde drew his attention to hundreds of plants of Thorn Apple, *Datura stramonium* at Thamesmead. Mr. Burton found one clump of *Carex strigosa* near the ornamental pond in Abbey Wood (51/48), and an uncommon alien grass *Urochloa panicoides* Beauv. on a refuse tip at Horn's Cross (57/T74) whence J. R. Palmer also reports *Rumex palustris*. It is pleasing that Mr. Palmer was also able to find a single clump of *Juncus maritimus* persisting on Swanscombe Marshes (67/T06) and he also supplied an interesting list of cultivated shrubs regenerating from seed in the Downe area. Mrs. L. M. P. Small's records include Musk, *Mimulus moschatus*, at New Eltham (47/T42). We are grateful to H. M. Pratt for his usual useful list of his observations in the Dartford district.

V.-c. 17, Surrey

A surprising discovery was the finding by Miss Ruth Hartas Jackson of a colony of a Marsh Orchis, *Dactylorhiza praetermissa* on Wimbledon Common. This was seen regularly until about thirty years ago in the Farm Bog but the new locality is in a different part of the Common (27/T20). She also found *Hordeum jubatum* L. on disturbed ground by the Kingston Road near Tibbett's Corner (27/T22). This beautiful grass has been found by new roads in several counties in recent years and is probably introduced with grass seed mixtures. On a wall by a church in the Upper Richmond Road, Putney (27/T24) she found *Geranium lucidum*, a species which tends to favour churchyards but not previously found so far into London.

Two ferns, *Asplenium adiantum-nigrum* and *Phyllitis scolopendrium*, from Mortlake parish-churchyard (27/T04) were localised by J. L. Gilbert with admirable precision as on the tomb of Henry Taylor who died in 1786! A grass on a bank near the Thames by Twickenham Bridge (17/T64) was determined for J. R. Palmer by Dr. A. Melderis as *Bromus x pseudothominii* P. Smith (= *B. thominii* auct.). In April C. W. Ward showed me a magnificent patch of Common Club Moss, *Lycopodium clavatum* on Banstead Heath (25/T24). In October, R. Clarke sent a specimen of *Cyperus eragrostis* Lam. from a clay-chalk bank below a garden at Warlingham (51/T35)—a handsome sedge which has become established in the Channel Islands.

V.-c. 18, South Essex

It is over forty years since our last record of Long-leaved Sundew, *Drosera intermedia* in Epping Forest, and then only one plant was seen. This year it was refound and B. T. Ward reports 20 plants. The grid reference is suppressed as this species is not known elsewhere within the Society's Area. The Purple Helleborine, *Epipactis purpurata*, was found by Mrs. L. M. P. Small in Epping Forest (49/T16) and her identification confirmed by Dr. D. P. Young. This is the first time this orchid has been reported to us from the Forest or the vice-county. From the Grays chalkpit (51/67), R. M. Burton noticed Pyramidal Orchid, *Anacamptis pyramidalis* and *Dactylorhiza fuchsii*, while Miss D. E. Woods found *Orchis mascula* in North Stifford Chalkpit (57/T88). From north of Grays (51/67) R. M. Burton reported the grass, *Apera spica-venti*. At the Exhibition Meeting of the Botanical Society of the British Isles a grass from our Area new to Britain was exhibited by Dr. A. Melderis. This was the American *Bromus pumpellianus* Scribn. which J. Whicker collected from the bank of a reservoir at Walthamstow in 1967. It is very closely allied to the Hungarian Brome, *Bromus inermis* from which it is distinguished by the lemmas being pubescent near the margins. From Banbury Reservoir, Walthamstow (39/T50) Mrs. Small sent me a specimen of *Rumex cristatus*.

V.-c. 19, North Essex

This has long been a rather neglected part of our Area and Miss M. E. Kennedy and D. H. Kent have again added a number of interesting species. These include *Thalictrum flavum* from the Stort Canal at Hunsdon Mead (41/T00) and east of Burnt Mill Station (41/T40); *Ranunculus trichophyllus* also E. of Burnt Mill Station (41/T40); *Apium inundatum* abundant on the edge of a pond on Harlow Common (40/T88); and *Anthemis arvensis* in arable land near Langridge (30/T84). In fields and roadsides near the site of Roydon Hall (41/T00) they found *Chenopodium bonus-henricus* and this was presumably the station reported by the Rev. P. H. Cooke in 1936. Miss Kennedy found Adder's Tongue, *Ophioglossum vulgatum* in abundance in a water meadow at Hunsdon

Mead (41/T00) and *Genista tinctoria* on the verge of a wood near Harlow Crematorium (40/T46) and Mr. Kent reports *Pentaglottis sempervirens* from the Town Park at Harlow (41/T40).

V.-c. 20, Herts.

Several members have made useful additions to our records for Hertfordshire. E. B. Bangerter added *Avena fatua* from near Colesdale Farm (20/T80), *Epilobium roseum* from north of Cooper's Lane Road (20/T80), *Agrostis gigantea* from Jack's Hatch (29/T64) and, with Miss Kennedy, *Campanula trachelium* and *Mentha spicata* from a gravel pit east of Hoddesdon Park Wood (30/T48). Miss Kennedy reports *Mentha x niliaca* from Cuffley (30/T02), *Melissa officinalis* from Northaw (20/T82), *Kickxia spuria* from near Cassiobury Park (09/T86), and, with P.C. Holland, *Arum italicum* from Roxford Copse (31/T00). From Bushey Mrs. Small sent *Oxalis europaea.*

V.-c. 21, Middlesex

The joint field meeting of BSBI/LNHS members arranged by E. J. Clement and T. B. Ryves on October 4 visited refuse tips at Shepperton, West Drayton, Harefield and New Year's Green and an account of the interesting adventives seen will no doubt appear in *Watsonia.* At the end of the day *Portulaca oleracea* was shown as a weed in flower beds near the Tower of London (38/T20).

On waste ground at the junction of Harrow Road and Edgware Road (28/T60), *Digitaria ciliaris* (Retz.) Koel. (= *adscendens* (H. B. K.) Henrard) was found by Don Turner and in Newgate Street, in the City (38/T20) R. M. Burton found *Spergula arvensis.* In Bishop's Park, Fulham (27/T46) Mrs. W. Roberts noted *Orobanche minor*, and Mrs. J. McLean collected *Epilobium lanceolatum* (confirmed by D. H. Kent) from a roadside at Ealing (18/T80), the first record from the west part of Middlesex. Miss M. E. Young had *Kickxia elatine* in her window-box in Elm Park Lane, Chelsea (27/T68) and *Humulus lupulus* grew nearby. Mrs. Small reports *Bunias orientalis* from a canal path at Greenford (18/T22). On a visit of the Quekett Club to Stanmore, A. Le Gros found the leaves of a bladderwort, which is probably *Utricularia neglecta*, in ponds near Wood Lane (19/T62).

We are grateful to the following for their contributions to our records during the year:—

E. B. Bangerter, R. M. Burton, R. Clarke, E. J. Clement, Mrs. P. O. Dunkley, Mrs. M. C. Foster, J. L. Gilbert, Mr. and Mrs. P. R. Greenwood, P. C. Hall, P. C. Holland, F. J. Holroyde, Miss R. Hartas Jackson, Miss M. E. Kennedy, D. H. Kent, A. Le Gros, J. E. Lousley, W. Mackintosh, D. McClintock, Mrs. J. McLean, Dr. A. Melderis, J. R. Palmer, H. M. Pratt, B. R. Ratcliffe, Mrs. W. Roberts, T. B. Ryves, Mrs. L. M. P. Small, D. E. Turner, B. T. Ward, C. W. Ward, J. Whicker, P. Widgery, Miss D. E. Woods, Miss M. E. Young, and Dr. D. P. Young.

London's Lichens

By J. R. Laundon

Department of Botany, British Museum (Natural History)

This "Glorious and Antient City . . . should wrap her stately head in Clowds of Smoake and Sulphur, so full of Stink and Darknesse"—

J. Evelyn, *Fumifugium* (1661).

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SYNOPSIS

The past and present lichen flora within a radius of 16 kilometres from Charing Cross, the official centre of the monocentric conurbation of London, is described and analysed. The land-use of this Area comprises Central London, the Inner Urban Ring, the Suburban Ring, and three small "wedges" of the Green Belt Ring.

Air pollution by sulphur dioxide is the chief factor affecting the lichen flora. Early lichen records prove that this pollution was restricted to the small built-up part of London before the early nineteenth century, and that it spread over the whole Area around the middle of the nineteenth century to cause serious damage to the lichen vegetation. Since the curtailment of London's expansion in 1938 the continuous decline in the lichen flora appears to have been halted. At present the ground-level concentration of sulphur dioxide has remained fairly constant, and as a result there has been little recent change in the lichen flora. At present the largest numbers of species are found in north-west London in and near the Totteridge Green Belt and across south London, excluding Croydon, whilst the smallest numbers of species are found in the City and East End. Individual species, several of which have been mapped on the one kilometre grid, are either ubiquitous, circumurban, disjunct in an arc from north-west to south-east (via west and south), or south-western heathland, in distribution.

165 species have been recorded, of which 71 have been seen since 1950. The numbers of lichen species increase at advancing distances from the centre of London. 68 per cent of the present lichen flora occurs on calcareous substrata, which are favourable because of their high pH, as a result of which the sulphur is converted to a less toxic form. The good lichen flora of the remaining areas of heathland proves that terricolous lichens are able to survive in moderately polluted districts, probably because

of the narrow layer of purer air which occurs over urban turf. 65 per cent of the flora occurs on memorials in churchyards and cemeteries, chiefly on limestone in the former, where bird excreta promotes nitrophilous communities, and where some species survive as relics, unable to colonise new surfaces. Only 11 per cent of the flora survives in woodland, this lichen habitat being the most adversely affected by air pollution.

Lichen conservation requires a reduction in sulphur dioxide concentration, and the preservation of surviving semi-natural vegetation, important old limestone churchyard memorials, and old walls.

The detailed records on which these conclusions are based are given under the heading "Lichen Flora".

INTRODUCTION

The rapid increase in the population of the world results in an increasing amount of rural land being utilised for urban development. When urbanisation occurs, and rural habitats are destroyed, restricted or altered, many plants and animals are lost, whilst others are able to adapt themselves to the new environment and therefore manage to survive. Species associated with man-made habitats become established, replacing those which have disappeared. For planning and conservation it is important to know the changes in wild life which are to be expected when urbanisation takes place. Comparative studies of the flora and fauna of rural areas with those of existing towns may provide many of the answers. The monocentric conurbation of London is especially suitable for studies of wild life in a completely urban environment, because of its large size and because of the diversity of habitats within the built-up area.

This study of the lichen flora has been carried out strictly within a radius of 16 kilometres (9·9 miles) from the official centre of London, namely the statue of King Charles I at Charing Cross, on the south side of Trafalgar Square, Westminster. The perimeter of the circle passes through Enfield, Woodford, Barking, Woolwich, Bromley, Croydon, Kingston, Isleworth, Harrow on the Hill, and New Barnet (Fig. 1). This includes 804 sq. km. (310 sq. miles), almost wholly built-over and all within the administration of Greater London. It is subsequently referred to as the Area.

This account of the lichen flora includes a digest of my paper in *The Lichenologist* (Laundon, 1967), excluding sociology, history of lichen study, introduced and excluded species; the editor of *The Lichenologist* is thanked for his permission to make extensive use of the earlier article. This present work gives more detailed consideration to the distribution of lichens in London in relation to air pollution, incorporates recent records, and includes more locality data than was possible in the earlier study. Since *The Lichenologist* article was published, 45 old churchyards not previously examined were visited in order to obtain better distributional coverage. Nine species, *Buellia canescens*, *Catillaria lenticularis*, *Lecanora contorta*, *L. polytropa*, *Lecidea fuscoatra*, *Parmelia sulcata*, *Polyblastia dermatodes*, *Stereocaulon nanodes* and *Toninia aromatica* have been added to the present lichen flora of the Area, and the percentages previously published have been adjusted accordingly. These additions are chiefly of species long present but not previously found, although it is possible that *Buellia canescens*, *Parmelia sulcata* and *Stereocaulon nanodes*

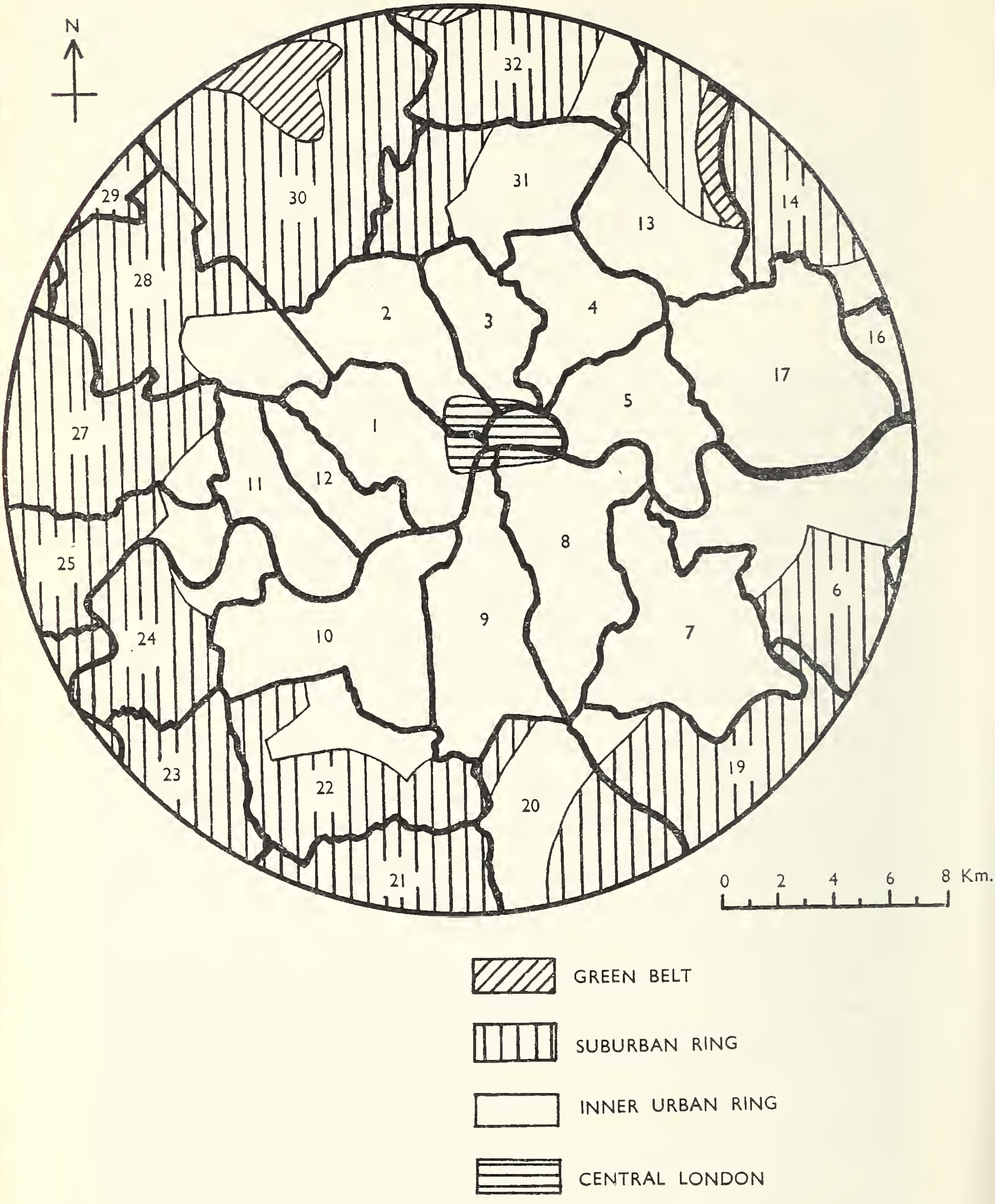

FIG. 1. Map of the Area showing the land-use of the London boroughs. The thick lines mark the boundaries of the boroughs and the River Thames. The corresponding names to the official numbers of the boroughs are given on p. 40, whilst the City of London has no number. The borough boundaries are drawn from a map published by the *Evening Standard*. The Figure is reproduced with permission from *The Lichenologist*.

may be recent arrivals. The last two are the most interesting of the new records. The single *Parmelia sulcata* plant was found by E. T. Rose on concrete coping in Haringey, which is one of the more polluted boroughs in the Area; this species is predominantly corticolous in south-east England, but is unlikely to occur today on bark in the Area. *Stereocaulon nanodes* has only recently been found in Britain in rural Somerset and Teesdale, and therefore its occurrence in an urban area is of special interest. Only two old records additional to *The Lichenologist* account have been discovered.

TOPOGRAPHY

In medieval times the only built-up part of London was the City, whilst Westminster formed an isolated precinct further up the River Thames. "Farther afield the open country stretched away on all sides, dotted with villages, hamlets and manor houses, much as in parts of England where no great city lay" (Pevsner, 1952, p. 13). Expansion along the River took place during the 16th and early 17th century so that Westminster and the City became linked by continuous buildings, which also extended eastwards to Stepney. By the middle of the 18th century most of Westminster and parts of Kensington, St. Marylebone, Holborn, Finsbury, Shoreditch, Bethnal Green, Stepney and Bermondsey had been built over. In the early 19th century huge new docks were built in the East End and vast slum housing formed around them. Later the construction of railways, tramways and piped water supply enabled London to make much more rapid growth so that most of the old county of London, excluding parts of the south-east, had become built over by the early twentieth century, and the Inner Urban Ring (Fig. 1) completed. Between the World Wars, aided by the development of electric railways, new suburbs were built to more spacious standards all around London, thus creating the Suburban Ring (Fig. 1). In 1938, The Green Belt (London and Home Counties) Act was passed which halted further extensions of London, and ensured that a rural zone encircled the urban area. The Act "was passed to preserve from industrial or building development areas of land in and around the administrative county of London in the interest of the health and amenity of persons living in this county" (Burrows, 1950, p. 229). The Town and Country Planning Act of 1947 ended almost all uncontrolled development in Britain by making new building subject to planning permission. This Act has been effectively used to ensure the survival of the Green Belt, and to contain London to the boundaries reached in 1938 except for some infilling.

This growth of London over a long period has resulted in distinct types of development (Abercrombie, 1945, p. 22) forming irregular rings (Fig. 1):

1. *Inner Urban Ring*. This comprises that part of London which was built over before the First World War in 1914, and extends from about 10 kilometres on the west side of the centre of London (Charing Cross), to about 16 on the east. It is characterised by high density Victorian terraced housing with a maximum of 75 to 200 persons to the acre (0·00405 sq. km). The housing is particularly characterised by the use of sash windows and the presence of projecting rooms at the rear. The chief industrial areas are Lea Valley—Lower Thames Side, Wandle

Valley and parts of north-west London. In this study Central London, defined by Abercrombie (*op. cit.*) as the "Commercial, Administrative and Cultural Centre of Greater London", and bounded by Euston, Aldgate, Waterloo and Green Park (Fig. 1), is separated from the Inner Urban Ring. The whole of Central London and almost the whole of the Inner Urban Ring occurs within the Area.

2. *Suburban Ring.* This includes that part of London which was built over between 1918 and 1938, and extends from the Inner Urban Ring to a radius of about 19 kilometres from the centre of London. It is characterised by low density mainly semi-detached housing, with sizable gardens at front and rear and wide, tree-lined roads with asphalt or grass verges. The housing is particularly characterised by the use of casement windows and the absence of back projections. The maximum density is 30 to 50 persons to the acre (0·00405 sq. km). The inner part of this Ring occurs within the Area.

3. *Green Belt Ring.* This includes that part surrounding London from which building has been prohibited since 1938. It occupies a zone extending from the Surburban Ring to a radius of about 32 kilometres from the centre of London. It is characterised by its predominantly rural character, which varies from unspoilt open countryside to the horrors of subtopia. The Green Belt is represented in the Area only in north London, by the "wedges" of countryside of Oakwood, Totteridge and Walthamstow (Epping Forest) (Fig. 1).

The vast size of the built-up area of London affects the climate. Reduced winter sunshine, higher temperatures in almost all times and lowered humidities are amongst the characteristics of London in comparison with the surrounding countryside. Chandler in Coppock & Prince (1964, p. 47) reports that "throughout the year the differences in minimum temperatures in central districts and in the country areas around London average 1·9°C (3·4°F) by night and 0·6°C (1·1°F) by day, but on individual nights the difference may be as much as 9°C (16°F)." Air pollution, which might also be considered as part of the climate, is discussed below. The low rainfall of between approximately 53 and 74 centimetres (21 to 29 inches) makes London unfavourable for oceanic lichens.

Much of the soil overlies London Clay, but some low hills of sand and gravel occur on which heath communities are developed. Outcrops of hard acid rock are absent, and the chalk within the Area forms only a short narrow strip in the extreme south which has been built over. The whole of the land is below 150 m. in altitude.

AIR POLLUTION AND LICHEN DISTRIBUTION

In 1273 the burning of coal in London was prohibited as being "prejudicial to health" (National Society for Clean Air, 1968, p. 46), but this law was later relaxed. In 1955 coal burning was again prohibited by declaring the City of London a smokeless zone, the first to be established in the Area. Until the 19th century air pollution was largely confined to the built-up parts of London, where its undesirable characteristics had been frequently commented upon over the preceding centuries. The impact of the Industrial Revolution resulted in the spread of pollution far beyond London and other cities so that the whole of the air over western Europe is now contaminated (see Junge, 1963, pp. 364-365). The Clean Air Act of 1956 enabled local authorities to establish Smoke Control Areas, which may be entirely smokeless (*i.e.* smokeless zones) or may make certain exemptions or impose special conditions. Sulphur dioxide is not controlled by the Act, except for a provision to promote its discharge through higher chimneys. At present 63% of Greater London is covered by Smoke Control Areas, and the whole programme should be completed by 1978. The establishment of Smoke Control Areas in districts of older houses has been shown to lead to reductions in smoke concentrations of up to 45%, and reductions in sulphur dioxide concentrations of up to 20% (Anon., 1968, p. 55).

Over London as a whole, significant changes are taking place in both the emissions and the concentrations of air pollutants. The rapid and widespread introduction of Smoke Control Areas, together with the dramatic decline in domestic coal consumption, has led to both the emissions and ground-level concentrations of smoke in London being reduced by about two-thirds between 1956 and 1965 (Anon., 1968, p. 50). The emission of sulphur dioxide has increased by about 30% between 1952 and 1965, partly due to increased fuel consumption by the electric power industry. However the ground-level concentration of sulphur dioxide in London has remained fairly constant, partly because large quantities are dispersed from tall chimneys into the upper atmosphere. Smoke pollution at any point depends on the density of the population, and on the coal consumption per head of population, in a relatively small area surrounding that point (Williams, 1960), whilst sulphur dioxide pollution shows no strong correlation with population density, because of the large emissions from industrial and electricity works. The approximate average concentration of sulphur dioxide pollution for the year ending March 31, 1958 for the Area is shown in Fig. 2. All pollution shows a similar proportional annual variation, so that the depicted pattern applies in all recent years. The heaviest pollution of sulphur dioxide occurs in central London, with high concentrations to the east and west and lower levels to the north and south. Entirely accurate distribution maps of average pollution levels over large areas are generally considered to be impossible to draw. The predominance of westerly winds appears to have little overall effect on the distribution of sulphur dioxide pollution in London (see Department of Scientific and Industrial Research, 1945, for a discussion of this same phenomenon relating to Leicester).

Air pollution is the chief factor affecting the distribution of lichens in London. Lichens accumulate a wide range of substances from water (usually rainwater) passing over their thallus, and it appears that when an area becomes polluted, thalli also absorb contaminating substances and so build up lethal concentrations (see D. C. Smith, 1962, p. 562). Rao & LeBlanc (1966), however, consider that pollution directly harms the algal symbiont, thus impairing the metabolic processes in the lichen. Whatever the truth, the polluted air of towns prevents many species of lichen from becoming established. Smoke, carbon monoxide, sulphur dioxide and grit and dust are the chief air pollutants, and it is the sulphur dioxide which appears to be the one which is harmful to lichens. A correlation between the numbers of lichen species present and the concentration of sulphur dioxide in the air is demonstrated by Skye (1958, p. 159, Fig. 6; 1964, p. 330), and by Gilbert in Goodman *et al.* (1965, p. 42),

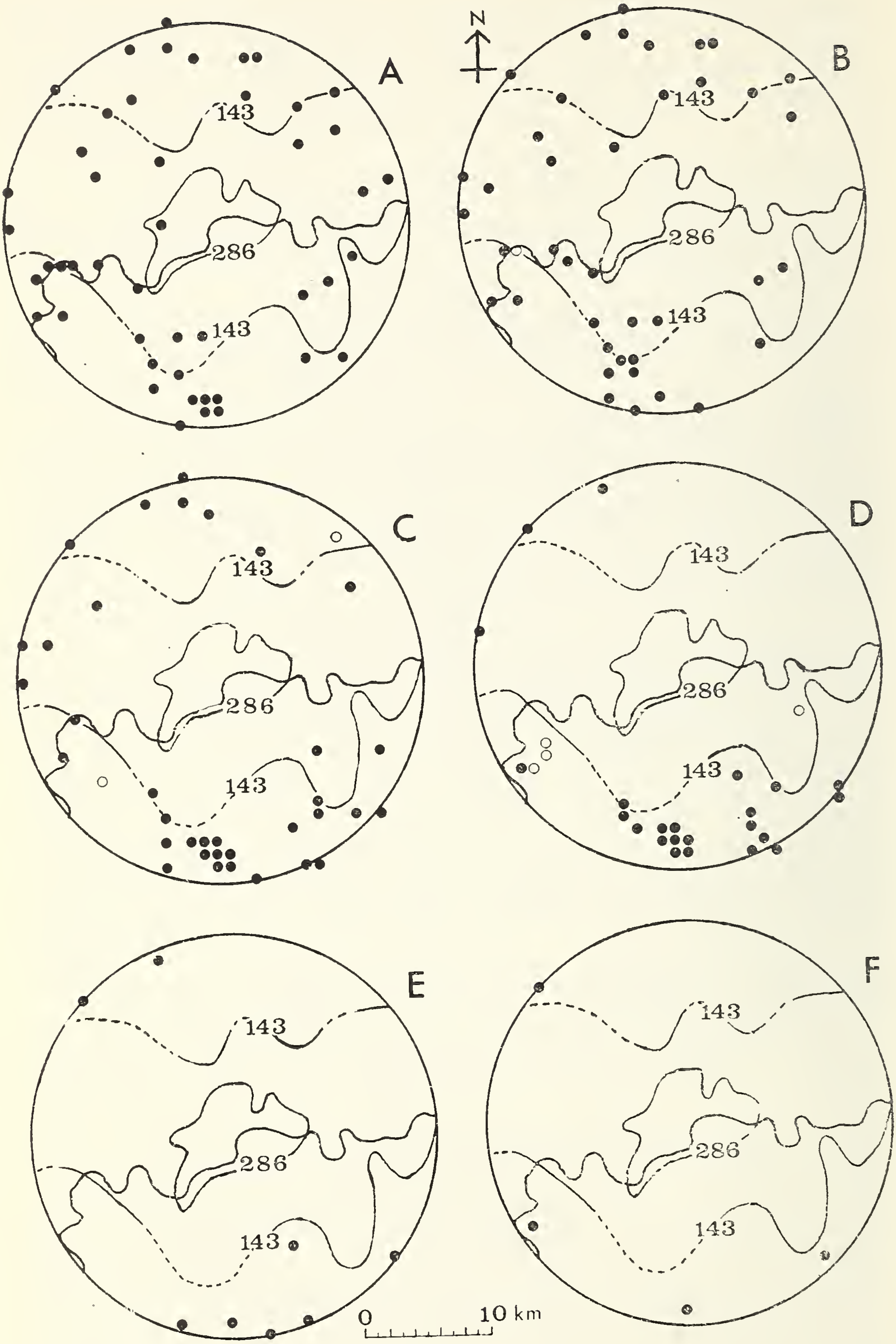

FIG. 2

who also shows a lack of correlation between the lichen flora and the level of smoke pollution. One kilometre grid maps of the London distribution of lichens show a direct relationship with sulphur dioxide levels (Fig. 2). Gilbert (*op. cit.*, p. 43) shows that the sulphur content of the thallus of *Parmelia saxatilis* increases considerably as the quantity of sulphur dioxide in the air becomes greater. Grit and dust, which frequently cover thalli in towns between rain, may not be harmful in themselves, because roadside dust frequently covers lichens in rural areas and nitrophilous species appear to thrive on it (see Barkman, 1958, p. 103; Gilbert, *op. cit.*, p. 40). The absence of many lichens from towns cannot be solely attributed to the lower relative humidity (see Chandler, 1967), as Rydzak (1959) has claimed (see Laundon, 1967, p. 283).

The lichen records for the Area dating back to the late 17th century indicate the effects of air pollution on the lichen flora at different times. Forster's late 18th century records of such toxiphobous lichens as *Anaptychia ciliaris*, *Arthonia radiata*, *Arthopyrenia* spp., *Candelaria concolor*, *Graphis scripta*, *Lecanora pallida*, *Lecidea limitata*, *Opegrapha atra*, *Phaeographis dendritica*, *Thelotrema lepadinum* and *Usnea* spp. from tree boles in and around Walthamstow, 11 kilometres from the centre of London, prove the lichen flora to have been unaffected by air pollution during this period. Therefore air pollution affected the lichen flora only in the small built-up area of London before the early 19th century. In 1865-68 and 1881-82 Crombie visited the Walthamstow district and other parts of Epping Forest and found that the lichen flora has declined markedly due to the spread of pollution, whilst "about Hoe Street, Walthamstow . . . where numerous species were collected by Forster . . . we would at present vainly search for any in a fully-developed condition" (Crombie, 1885, p. 74). Indeed, Crombie (*op. cit.*, pp. 56-70) recorded no lichens at all from Walthamstow, although a few species were doubtless present in St. Mary's churchyard, since they still survive there today. By 1881 Crombie (*op. cit.*, p. 71) noted that lichens which "were both general and plentiful" in Epping Forest in 1865 were "now to be seen only here and there in very small quantity". Thus the main decline in London's lichen flora appears to have taken place under the major impact of the Industrial Revolution around the middle of the 19th century, when polluted air first spread far beyond the built-up area.

During and after the late 19th century the lichen flora continued to decline as London expanded, but at a much slower rate. As late as 1929-33 specimens of *Parmelia* were collected in Richmond Park. The

FIG. 2. Distribution of lichens in order of "increasing sensitivity" to air pollution by sulphur dioxide. A—*Candelariella medians*, B—*Caloplaca heppiana*, C—*Physcia orbicularis*, D—*Xanthoria parietina* (agg.), E—*Physcia adscendens*, F—*Physconia grisea*. The closed circles represent post-1950 records from 1 km grid squares, whilst the open circles represent pre-1950 records; some old records are excluded because of lack of precise localities. The lines show the average concentration of sulphur dioxide in microgrammes per cubic metre, the inner being equivalent to 10 parts per 100 million, and the outer to 5 parts per 100 million, from April 1957 to March 1958. Where these lines are broken there is uncertainty as to their precise location. The wavy line across the centre denotes the River Thames. The sulphur dioxide levels are taken from Chandler (1965, Fig. 30) with permission, and the London Natural History Society's Recording Map is used as a base.

curtailment of London's expansion in 1938 through the passing of The Green Belt (London and Home Counties) Act has brought relative stability to the lichen vegetation of the Area, and later changes have been minimal. This is because all new urban development results in a local increase in air pollution, and the containment of London has prevented any major extension to the area of pollution.

In recent years sulphur dioxide concentrations have remained fairly constant and there has been little change in the lichen flora. A few minor improvements indicate that the long period of decline since the early 19th century may have been finally halted. At Holland Park (Kensington and Chelsea) *Lecanora conizaeoides* was scarce on tree boles in both 1953 and 1967 in the northern section of planted woodland, but whereas it was seen on only two boles in the public walks in 1953, small thalli occurred on 14 in 1967. No change in the status of the lichens in the Central Parks has been observed, but green algae are increasing on tree boles.

Out of a total of 165 species recorded for the Area, 71 have been observed since 1950. Nearly all of those which have not been refound are now extinct. It appears likely that the total number of lichens in the Area in the early 19th century exceeded 200, for the early botanists frequently ignored saxicolous lichens because of collecting difficulties. The decline to the present 71 is primarily due to the increase in air pollution, but the destruction of suitable habitats accounts for some of the losses. It appears that any small changes in the lichen flora in the immediate future will be because of changes in land-usage, and not because of changes in pollution levels.

The present distribution of lichens in London is an indicator of the concentration of sulphur dioxide in different localities. In places where few species occur sulphur dioxide levels are high, but where a number of lichens are present the sulphur dioxide pollution is less severe. The present numbers of lichen species recorded in the London boroughs are shown in Fig. 3; terricolous records are excluded because these are concentrated in the south-west of London in relict heathland, and their distribution bears little relationship to air pollution. The following conclusions can be drawn from the map:

1. There is no one part of the Area which has a very rich lichen flora in comparison with the remainder.

2. The largest numbers of species are found in north-west London in and near the region of the Totteridge Green Belt (Fig. 1), and across south London, excluding Croydon. Croydon has much high density Inner Urban Ring housing and the Waddon industrial area, and would therefore be expected to have a poorer flora than the neighbouring predominantly Surburban Ring boroughs.

3. The largest numbers of species occur in the least sulphur dioxide polluted parts of London.

4. Low numbers of species occur throughout the inner districts, corresponding largely to the Inner Urban Ring (Fig. 1).

5. The smallest numbers of species are found in the City and East End, where there is high air pollution.

Studies of the present distribution of individual species, maps of some of which are shown in Fig. 2, indicate that the following types of lichen distribution occur in London:

1. *Ubiquitous species.* This group comprises lichens which are found

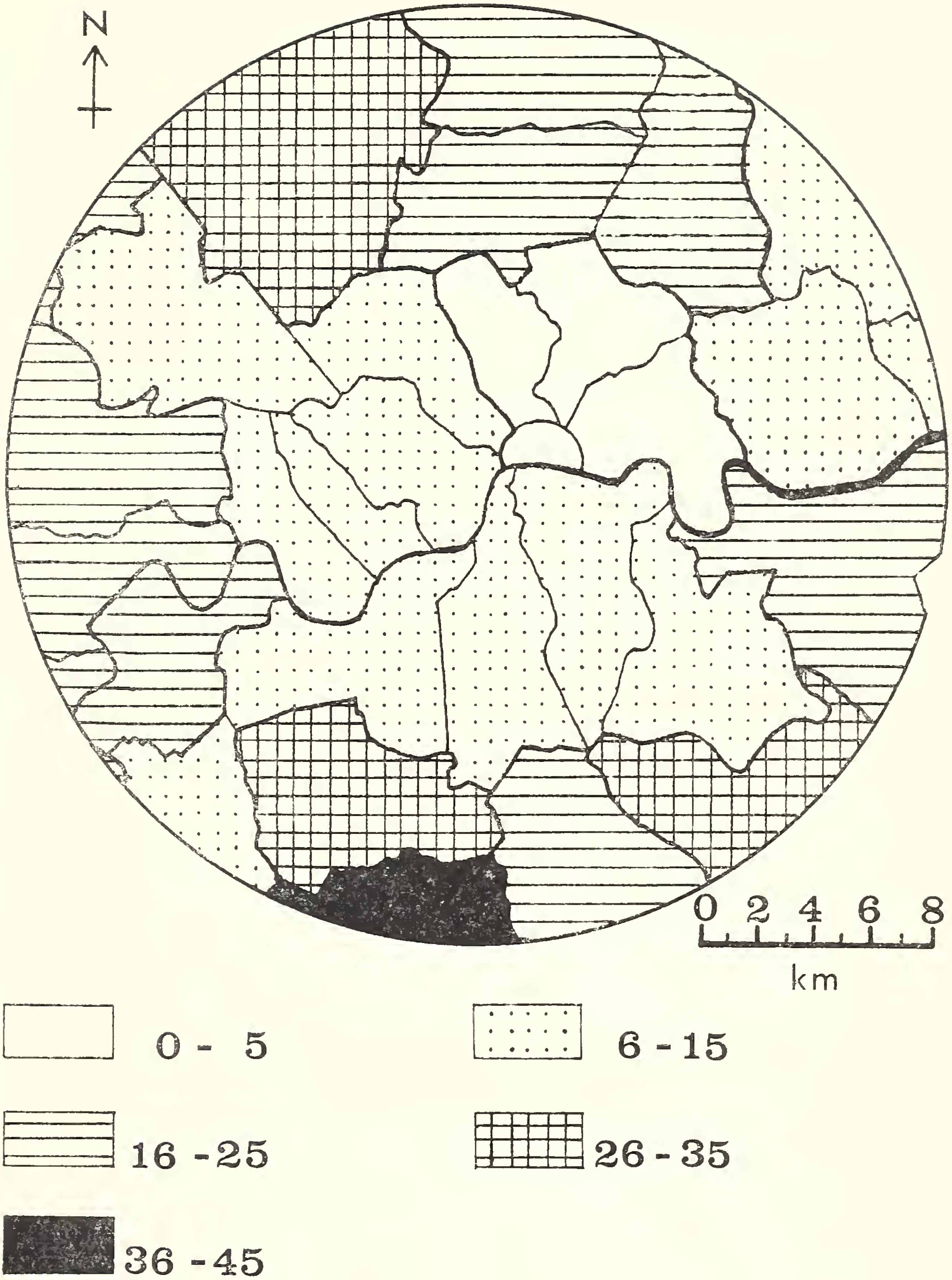

FIG. 3. Map showing the present numbers of lichen species, excluding terricolous records, found within the Area in the London boroughs.

throughout the whole of London and which can therefore withstand very high levels of air pollution. *Lecanora dispersa* is the only representative of this group.

2. *Circumurban species.* This group consists of lichens which have an orbicular distribution around central and east London from where they are absent because of the high air pollution. Some species (*e.g. Caloplaca citrina, C. teicholyta, Candelariella medians* (Fig. 2A), *Lecanora conizaeoides*) are completely circumurban, whilst others which are more sensitive to pollution (*e.g. Caloplaca heppiana* (Fig. 2B), *Physcia caesia, P. orbicularis* (Fig. 2C) and *Rinodina subexigua*) are circumurban apart from their absence from the low-lying eastern districts of Newham, Barking and Woolwich, which are polluted from industrial Lower Thames Side.

3. *Disjunct species.* This group comprises pollution-sensitive lichens restricted to an arc from north-west to south-east London, via west and south. The species (*e.g. Lecidea lucida, Physcia adscendens* (Fig. 2E), *Physconia grisea* (Fig. 2F) and *Xanthoria parietina* (agg.) (Fig. 2D), chiefly represented in the Area by *X. aureola*) are scarce in scattered localities within the arc.

4. *South-western heathland species.* This group consists of terricolous lichens now confined to the acid heaths of south-west London. The species (*e.g. Cladonia coccifera, C. floerkeana, Cornicularia aculeata* (for distribution map see Laundon, 1967, Fig. 2A)) are not restricted by air pollution like the circumurban and disjunct species, but by the occurrence of suitable habitats.

HABITATS

The survey of the Area shows that the popular view that London is devoid of lichens is incorrect. However the present total of 71 species is not large when compared with the 73 species recorded recently from the small area of Bookham Commons (Laundon, 1958), situated only 29 kilometres from the centre of London. The Bookham Commons survey covered only 1·54 sq. km in comparison with the present area of 804 sq. km. All post-1950 records are considered as belonging to the present, and are analysed in relation to the London Rings, distance from the centre, substrata and habitats. The distribution in relation to air pollution has been discussed above.

A. London Rings

The London Rings have already been described, and the left-hand columns of Table 1 show their present lichen flora. One one species (1%) of the total London lichen flora, namely *Lecanora dispersa*, occurs in Central London. *L. dispersa* is also the only lichen occurring in Central New York (Brodo, 1966, p. 435), and it is evident that New York and London have the poorest lichen flora for their central areas of any towns on record. Their large size and high sulphur dioxide levels over a wide area probably account for this poverty. 45 species (63% of the flora) occur within the Inner Urban Ring of London, or on open spaces on its fringe, which is a high percentage for land built over before 1914. Predictably 64 species (90%) of the lichens in the Area occur in the Suburban Ring, where lower levels of pollution predominate. Records from the Green Belt Ring are not considered here, as such a small portion is included within the Area. *Bacidia sabuletorum, Chaenotheca ferruginea* and *Parmelia physodes* have been recorded from the Area only within the Green Belt Ring.

Table 1. The present lichens in the London Rings (excluding the Green Belt Ring) (left-hand columns) and their presence (+) in concentric circles drawn from the centre of London at Charing Cross (right-hand columns). C=Central London; I=Inner Urban Ring; S=Surburban Ring

				0-2	2-4	4-6	6-8	8-10	10-12	12-14	14-16 km
		S	*Acarospora fuscata*								+
		S	*Bacidia chlorococca*								+
		S	*B. herbarum*							+	
			B. sabuletorum								+
		S	*B. umbrina*							+	+
		S	*Buellia canescens*								+
		S	*B. punctata*							+	
	I	S	*Caloplaca aurantia*					+		+	+
	I	S	*C. citrina*		+		+	+	+	+	+
	I	S	*C. decipiens*					+	+	+	+
	I	S	*C. heppiana*				+	+	+	+	+
	I	S	*C. holocarpa*					+	+		+
		S	*C. murorum*							+	+
	I	S	*C. teicholyta*				+	+	+	+	+
	I	S	*Candelariella aurella*		+	+	+	+	+	+	+
	I	S	*C. medians*		+		+	+	+	+	+
	I	S	*C. vitellina*				+	+	+	+	+
	I	S	*Catillaria lenticularis*					+	+		+
			Chaeonotheca ferruginea								+
	I	S	*Cladonia bacillaris*					+		+	+
	I	S	*C. chlorophaea*			+	+	+	+	+	+
	I	S	*C. coccifera*					+	+		+
	I	S	*C. coniocraea*			+	+	+	+	+	+
	I		*C. crispata*					+			
	I	S	*C. fimbriata*			+	+	+	+	+	+
	I	S	*C. floerkeana*					+	+	+	+
	I	S	*C. furcata*					+	+	+	
	I		*C. impexa*					+			
		S	*C. macilenta*						+		+
	I	S	*C. pyxidata*			+				+	
		S	*Collema crispum*								+
	I	S	*Cornicularia aculeata*					+	+	+	
	I	S	*Lecania erysibe*		+	+	+	+	+	+	+
		S	*Lecanora atra*								+
	I	S	*L. calcarea*					+	+	+	+
		S	*L. campestris*							+	+
	I	S	*L. conizaeoides*	+	+	+	+	+	+	+	+
	I	S	*L. contorta*					+			+
C	I	S	*L. dispersa*	+	+	+	+	+	+	+	+
	I	S	*L. muralis*	+	+		+	+	+	+	+
	I	S	*L. polytropa*						+		+
	I	S	*Lecidea coarctata*				+		+	+	+
		S	*L. fuscoatra*								+
	I	S	*L. granulosa*					+	+		+
	I	S	*L. lucida*						+	+	+
	I	S	*L. stigmatea*		+				+	+	+
		S	*L. sulphurea*								+
	I	S	*L. uliginosa*					+	+	+	+
	I	S	*Lepraria incana*		+	+		+	+	+	+
		S	*Ochrolechia androgyna*						+		
			Parmelia physodes								+
		S	*P. sulcata*					+			
	I	S	*Physcia adscendens*					+			+
	I	S	*P. caesia*				+	+	+	+	+
		S	*P. nigricans*							+	
	I	S	*P. orbicalaris*					+	+	+	+
		S	*Physconia grisea*								+
		S	*Polyblastia albida*								+
	I		*P. dermatodes*						+		
		S	*Protoblastenia rupestris*						+		+
	I	S	*Rinodina subexigua*				+	+	+	+	+
	I	S	*Sarcogyne regularis*					+		+	+
	I		*Stereocaulon nanodes*					+			
	I	S	*S. pileatum*				+	+	+	+	+
		S	*Thelidium decipiens*								+
		S	*T. incavatum*								+
		S	*Toninia aromatica*							+	+
	I	S	*Verrucaria muralis*				+			+	+
	I	S	*V. nigrescens*			+	+	+	+	+	+
		S	*V. viridula*							+	+
	I	S	*Xanthoria parietina* (agg.)					+	+	+	+
1	45	64	TOTAL	3	9	10	19	39	38	42	59
1	63	90	%	4	13	14	27	55	54	59	83

B. DISTANCE FROM THE CENTRE

Concentric circles at two kilometre distances from the centre of London (Charing Cross) were drawn on Ordnance Survey Maps and the distribution of lichens within each circle was plotted on the right-hand columns of Table 1. The majority of corticolous and saxicolous species occur at several localities within a particular circle, whilst terricolous lichens are concentrated in south-west London where relict heathland survives. The results from the Table show that there is an increase in the numbers of species at advancing distances from the centre of London. This is correlated with the progressive average decline in pollution levels, housing densities and age of urbanisation at increasing distance from the centre of London.

C. SUBSTRATA

The present lichen flora on the five types of substrata which are present in the Area is shown in the left-hand columns of Table 2. Calcareous soil is absent as a lichen substrate. Calcareous stone includes limestone, concrete, mortar and asbestos-cement sheeting, whilst acid stone includes brick and sandstone. Calcareous stone is by far the richest substratum for lichens with 48 species (68%), because of its high pH value. Gilbert (1968, p. 15) suggests that a high pH influences the degree of ionisation and rate of oxidation of sulphite ions, so as to render them less harmful to lichen vegetation.

All other types of substrata support considerably fewer lichens. 21 species (30%) occur on acid stone whilst acid soil supports 15 (21%). Although air pollution is harmful to the lichen flora on acid stone, the list of records suggests that most acid terricolous lichens are unharmed. At Putney Heath, where there are extensive areas of heather (*Calluna vulgaris*), the lichen flora is essentially similar to that found on unpolluted heaths, with *Cladonia coccifera*, *C. crispata*, *C. floerkeana*, *C. impexa* and *Cornicularia aculeata*. Gilbert (1968, p. 24) shows that a layer a few centimetres deep of air containing much reduced sulphur dioxide, but with little reduction in smoke, occurs over urban turf, and it is probably this reduction which enables terricolous lichens to occur in urban areas. However, this phenomenon does not enable terricolous lichens to escape from the effects of particularly high sulphur dioxide levels, for they were absent from the bombed sites in Central London (see below). 36 terricolous species were recorded for the Area before 1950, and the decline to the present number appears to be mainly due to the destruction of habitats. The absence of *Peltigera* spp. from the Area at the present time is noteworthy, for apparently suitable habitats abound, and *P. rufescens* is abundant on the air polluted heaths around Scunthorpe, Lincolnshire (Seaward, 1966).

Nine species (13%) are found on bark and eight species (11%) occur on wood. These small numbers fully support the well-known fact that air pollution has a much greater adverse effect on corticolous and lignicolous species than on those on other types of substrata. Prior to 1950 50 species were recorded from bark in the Area, and 36 from wood, so their decline has been catastrophic.

D. HABITATS

The present lichen flora in different habitats is shown in the right-hand

TABLE 2. The present lichen flora on types of substrata (left-hand columns) and in different habitats (right-hand columns). *Chaenotheca ferruginea* and *Parmelia physodes* occur in habitats other than those listed.

Calcareous stone	Acid stone	Acid soil	Bark	Wood		Woods	Parks	Heaths and commons	Churchyards and cemeteries	Private gardens	Sewage farms	Reservoirs	Bombed sites	Old brick walls	Asbestos-cement roofs
	A				*Acarospora fuscata*					+				+	
			B		*Bacidia chlorococca*		+								
C					*B. herbarum*									+	
C					*B. sabuletorum*				+						
	A				*B. umbrina*									+	
C	A				*Buellia canescens*									+	
			B		*B. punctata*						+				
C					*Caloplaca aurantia*		+		+						
C					*C. citrina*		+		+	+	+	+		+	
C					*C. decipiens*				+	+	+			+	
C					*C. heppiana*		+		+					+	
C					*C. holocarpa*				+						
C					*C. murorum*						+				
C					*C. teicholyta*				+					+	
C					*Candelariella aurella*		+		+	+	+	+		+	+
C					*C. medians*		+		+		+				
C	A				*C. vitellina*				+		+	+		+	
C					*Catillaria lenticularis*		+		+						+
			B		*Chaenotheca ferruginea*										
		E			*Cladonia bacillaris*			+							
C	A	E			*C. chlorophaea*	+	+	+	+					+	
		E			*C. coccifera*			+							
C	A	E	B	W	*C. coniocraea*	+	+	+	+	+				+	
		E			*C. crispata*			+							
C	A	E	B		*C. fimbriata*	+	+	+	+		+	+		+	
		E			*C. floerkeana*		+	+							
		E			*C. furcata*	+	+	+							
		E			*C. impexa*			+							
	A			W	*C. macilenta*			+						+	
C		E			*C. pyxidata*		+		+						
C					*Collema crispum*				+						
		E			*Cornicularia aculeata*		+	+							
C	A				*Lecania erysibe*		+		+	+	+	+		+	+
	A				*Lecanora atra*									+	
C					*L. calcarea*				+						
C					*L. campestris*				+		+				
C	A		B	W	*L. conizaeoides*	+	+	+	+	+	+	+		+	
C					*L. contorta*				+						
C				W	*L. dispersa*		+	+	+	+	+	+	+	+	+
C	A			W	*L. muralis*		+		+	+	+	+		+	+
	A				*L. polytropa*				+	+					
C	A				*Lecidea coarctata*		+		+	+				+	
	A				*L. fuscoatra*									+	
		E		W	*L. granulosa*	+		+	+	+					
C	A				*L. lucida*		+		+	+				+	
C					*L. stigmatea*		+		+	+	+				+
	A				*L. sulphurea*									+	
		E		W	*L. uliginosa*	+		+							
C	A	E	B	W	*Lepraria incana*	+	+	+	+	+	+			+	
			B		*Ochrolechia androgyna*			+							
			B		*Parmelia physodes*										
C					*P. sulcata*					+					
C	A				*Physcia adscendens*		+		+	+				+	+
C					*P. caesia*		+		+	+	+	+			+
C					*P. nigricans*				+		+				
C					*P. orbicularis*		+		+	+	+			+	+
C					*Physconia grisea*				+					+	
C					*Polyblastia albida*				+						
C					*P. dermatodes*				+						
C					*Protoblastenia rupestris*				+						
C					*Rinodina subexigua*		+		+	+	+	+			+
C					*Sarcogyne regularis*		+		+	+				+	
		E			*Stereocaulon nanodes*									+	
	A				*S. pileatum*		+			+		+		+	
C					*Thelidium decipiens*				+						
C					*T. incavatum*				+						
C					*Toninia aromatica*				+					+	
C					*Verrucaria muralis*				+	+					
C					*V. nigrescens*				+						
C					*V. viridula*				+		+				
C	A				*Xanthoria parietina* (agg.)		+		+	+	+			+	+
TOTAL 48	21	15	9	8		8	29	17	46	24	21	11	1	32	11
% 68	30	21	13	11		11	41	24	65	34	30	15	1	45	15

columns of Table 2. 46 species (65%) of the total flora are found in churchyards and cemeteries, chiefly in the former because the memorials are older. A comparison of the percentages shows that this habitat is more important for lichens than all others. Only a few Central London churchyards which retain good collections of headstones (*e.g.* St. Bartholomew The Great, Little Britain, City) are devoid of lichens. Churchyards near the perimeter of London have a lichen flora on their limestone memorials which is often almost as rich as that on memorials in rural areas. St. Andrew, Totteridge, situated in the Green Belt, appears to have the largest number of species, 23 having been recorded. Many of the churchyard lichens occur in the nitrophilous community called *Caloplacetum heppianae* (see Laundon, 1967, pp. 296-300), which is characterised by an abundance of orange and yellow lobate *Caloplaca* and *Candelariella* species. The community is well-developed on limestone memorials (Plates 1 and 2) in old churchyards in the Suburban Ring and beyond, occurring on the top surfaces of headstones and near the outer edge of chest-tombs where there is maximum illumination and high nitrogen concentrations. The memorials are used as bird perches, and the lichens evidently obtain their nitrogen supply chiefly from the bird excreta which occurs in quantity amongst the lichen vegetation. The mite *Ameronothrus maculatus* (Mich.) occurs in many London churchyards, where it feeds on lichen thalli; it is possible that it may exterminate some species from certain churchyards, but this needs further investigation.

The community *Caloplacetum heppianae* survives in London churchyards as a relict from earlier times of rural surroundings and lower levels of air pollution, being absent from nearby cemeteries of more recent date. Thus at St. John, Hampstead, it is frequent on the oldest memorials in the 18th century churchyard, but is absent from the nearby Highgate Cemetery, which was not opened until 1838; evidently Camden was already becoming too polluted after 1838 for the community to spread to new areas. High levels of air pollution in the 19th century also prevented the *Caloplacetum heppianae* from establishing itself in the other early cemeteries of Abney Park (Hackney), opened in 1840, Brompton (Kensington and Chelsea) opened in 1831-40, and Kensal Green (Westminster) opened in 1833. Even in existing old churchyards the community is confined to the 18th and 19th century memorials and unable to colonise those erected in the present century. Thus at St. Peter and St. Paul, Mitcham, *Caloplaca heppiana* (here the principal component of the *Caloplacetum heppianae*) occurs on over 80% of the non-shaded limestone memorials erected in the 18th century (Plate 2), compared with none on those dating from the 20th century (Fig. 4); *Lecanora dispersa*, on the other hand, shows no decline in colonising ability. Rising levels of air pollution during the 19th century have made it increasingly difficult for *Caloplaca heppiana* to colonise new surfaces in Mitcham, with the result that all further colonisation ceased before 1900. Patterns of distribution which appear to indicate species in order of sensitivity to air pollution can therefore be misleading; Fig. 2 indicates that *Caloplaca heppiana* is less sensitive than *Physcia orbicularis*, but the reverse is the case today as regards present colonisation.

Old brick walls are the second richest habitat, on which 32 species (45%) are recorded. The early 18th century wall at Church Lane, Beddington, has 23 species (of which one, *Lecidea lucida*, appears to have become recently extinct), including the only known plants of *Buellia canescens*,

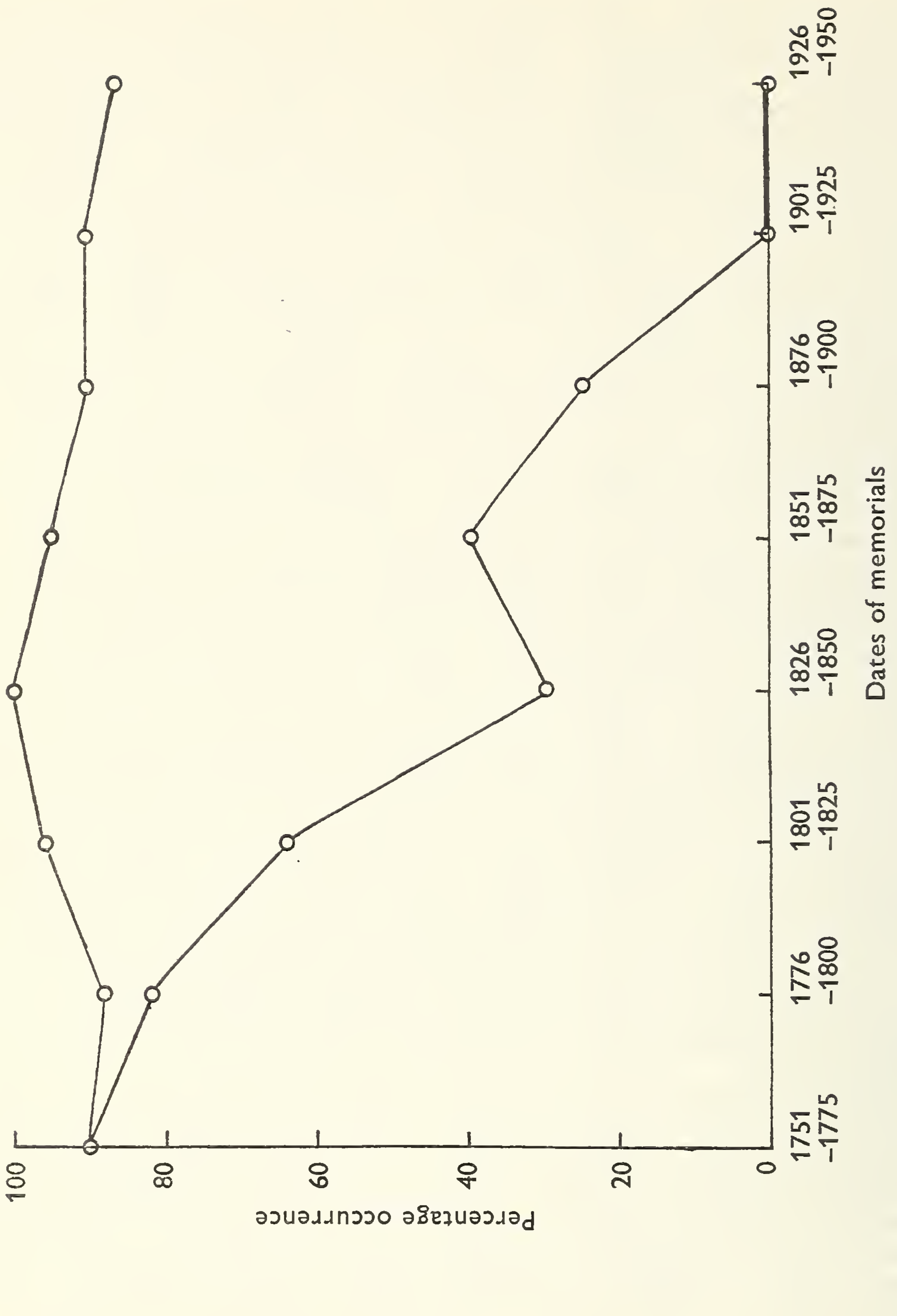

FIG. 4. The percentage occurrence of *Caloplaca heppiana* (lower graph) and *Lecanora dispersa* (upper graph) on limestone memorials erected from 1750 to 1950 at St. Peter and St. Paul's churchyard, Mitcham (London Borough of Merton).

Memorials beneath trees and/or with illegible dates were excluded. Numbers of stones studied: 1751-1775: 10; 1776-1800: 17; 1801-1825: random sample of 25; 1826-1850: 7; 1851-1875: random sample of 20; 1876-1900: random sample of 20; 1901-1925: random sample of 20; 1926-1950: 7. The inconsistency in the graphs for the period 1826-50 is due to the small number of memorials erected between these dates. The churchyard is surrounded by old terraced housing and paint factories. The Figure is reproduced with permission from *The Lichenologist*.

Lecanora atra, *Lecidea fuscoatra* and *L. sulphurea*, and is the richest for lichens in the Area. Although sections of this wall are repaired every few years, it is fortunately never cleaned and it retains its relict lichen flora. Extensive old brick walls occur around Ham House and these are characteristic of others in the Area with *Candelariella vitellina* on their vertical surfaces and *Lecanora muralis* on their coping.

Parks provide a habitat for 29 species (41 %). They have a wide variety of substrata, including heathland at Richmond Park, rock gardens at Carshalton, Kew (both acidic) and Regent's Park (calcareous), and old limestone monuments at Morden Hall and Syon Parks. In central London, parks are the only large open spaces which are accessible to the public, and their lichen flora is of potential importance in assessing future changes due to alterations in air pollution levels. These Central Parks form a continuous open space over four kilometres in length, and their present lichen flora is shown in Laundon (1967, Table 3), with the addition of *Cladonia fimbriata* from Kensington Gardens. *Lecanora conizaeoides* is absent from both St. James's and Green Parks, and is scarce in both Hyde Park and Kensington Gardens, whilst the area called The Fountains in Kensington Gardens has richly developed saxicolous communities on the limestone edge of four ponds and on an old limestone wall, where the proximity of water and the abundance of bird excreta have created conditions more suitable for the growth of some lichens than would otherwise be possible.

24 species (34 %) are recorded from private gardens, which form the most extensive habitat in London. Asbestos-cement roofs are the most important substratum for lichens in gardens, but old walls and concrete bird-paths and pond edges are also occasionally of lichenological interest.

21 species (30 %) occur at sewage farms, chiefly on concrete. Beddington Sewage Farm (Plate 3) is the most interesting, and is the only known locality for *Buellia punctata*, *Caloplaca murorum* and *Verrucaria viridula* forma *tectorum* in the Area. This Farm is also the only extensive site for the *Physcietum caesiae* (see Laundon, 1967, pp. 300-301), a nitrophilous community chiefly composed of *Lecanora muralis*, *Physcia caesia* and *P. orbicularis*, in the Area. This community is now known to occur occasionally on asbestos-cement roofs, on a tiled roof at Shirley and in one place on concrete on the eastern side of Banbury Reservoir. At Beddington the community occurs on the concrete tops of the sides of open channels, constructed in the early part of this century, which distribute the effluent over a wide area to and from the irrigation fields on the west side of Beddington Lane (Plates 3 and 4). *Physcia caesia* is generally dominant, in many places forming a continuous mat extending for several hundreds of metres. The related community *Caloplacetum heppianae* (see above), here generally dominated by *Candelariella medians*, also occurs at Beddington, mainly on the east side of Beddington Lane. It grows on the concrete sides and on some of the tops of the circular bacteria beds (also called biological filters or sprinklers) and on the concrete tops of the effluent channels in the area of these beds, where the sewage is more concentrated. Lichens are absent from the media surfaces of the bacteria beds and from most of the horizontal tops of their walls, apparently because of occasional wetting by wind-blown liquid sewage from the rotating distributors. Edmondson in Jones (1961, pp. 102-104) gives an excellent account of the purification of sewage at South Norwood

Sewage Farm, and that at Beddington is at present operated in a similar manner.

Heaths and commons support 17 species (24%). Today all areas which are of importance for terricolous lichens are situated exclusively in south-west London. Most outstanding are Putney Heath and Wimbledon Common, where extensive relict tracts of *Calluna vulgaris* survive. Areas of *Calluna* are generally rich in lichens and those in London are no exception. A grass-heath, dominated by *Agrostis tenuis*, occurs at Barnes Common and contains *Cladonia furcata* in abundance.

Eleven species (15%) have been recorded from asbestos-cement roofs. The importance of this substratum for lichen colonisation in London has been emphasised by Brightman (1959), who attributed its favourable nature chiefly to its high water-absorbing power, high base content and fibrous texture. Although asbestos-cement roofs in London usually become completely covered in lichens after several years, their flora is remarkably uniform and poor in numbers of species. *Candelariella aurella*, *Lecanora dispersa*, *L. muralis*, *Lecidea stigmatea* and *Rinodina subexigua* are often abundant, and where the air is less polluted, as in parts of the Suburban Ring, the foliose *Physcia orbicularis* and *Xanthoria aureola* become common. The present use of asbestos-cement as a roofing material for pre-fabricated buildings has enabled *Lecanora muralis*, *Lecidea stigmatea*, *Physcia orbicularis*, *Rinodina subexigua* and *Xanthoria aureola* to become much more abundant and widespread than would be the case if this substratum had never come into general use. Unfortunately, difficulties of access have prevented a thorough examination of asbestos-cement roofs in London. This is regrettable, for detailed recording from this habitat would prove highly valuable in the mapping of lichens in relation to air pollution, and would enhance the distribution maps of *Physcia orbicularis* (Fig. 2C) and *Xanthoria parietina* (agg.) (Fig. 2D).

Eleven species (15%) occur on the sides of reservoirs. The Lea Valley Reservoirs have sides of concrete with an abundance of *Candelariella aurella*, *C. vitellina*, *Lecania erysibe* forma *sorediata*, *Lecanora dispersa*, *L. muralis* and *Rinodina subexigua* on their top horizontal ledges, the flora having affinities with that of the concrete channels at sewage farms. Barn Elms Reservoirs have brick sides, which are notable for the abundance of *Stereocaulon pileatum*.

Semi-natural woodland supports only eight species (11%), and these low figures indicate that urban development, by increasing air pollution, adversely affects woodland more than any other type of habitat. Woodland is normally the richest habitat for lichens where pollution levels are low, and the absence from the London woods of such common species as *Evernia prunastri*, *Lecanora expallens*, *Parmelia* spp. and *Pertusaria* spp. is striking. About 25 small areas of semi-natural woodland survive in the Area, all dominated by *Quercus robur* or *Q. petraea* when mature, and the lichens which occur on bark and wood in 16 of them are shown in Laundon (1967, Table 4). *Lecanora conizaeoides* occurs in all of them, but other species in less than half. The development of the lichen vegetation depends on the growth of the shrub layer which provides shelter and increased humidity (see below).

After the Second World War bombed sites covered large parts of the City and East End. These sites, produced by the demolition of buildings ruined by enemy action, were rubble and earth-covered basements open

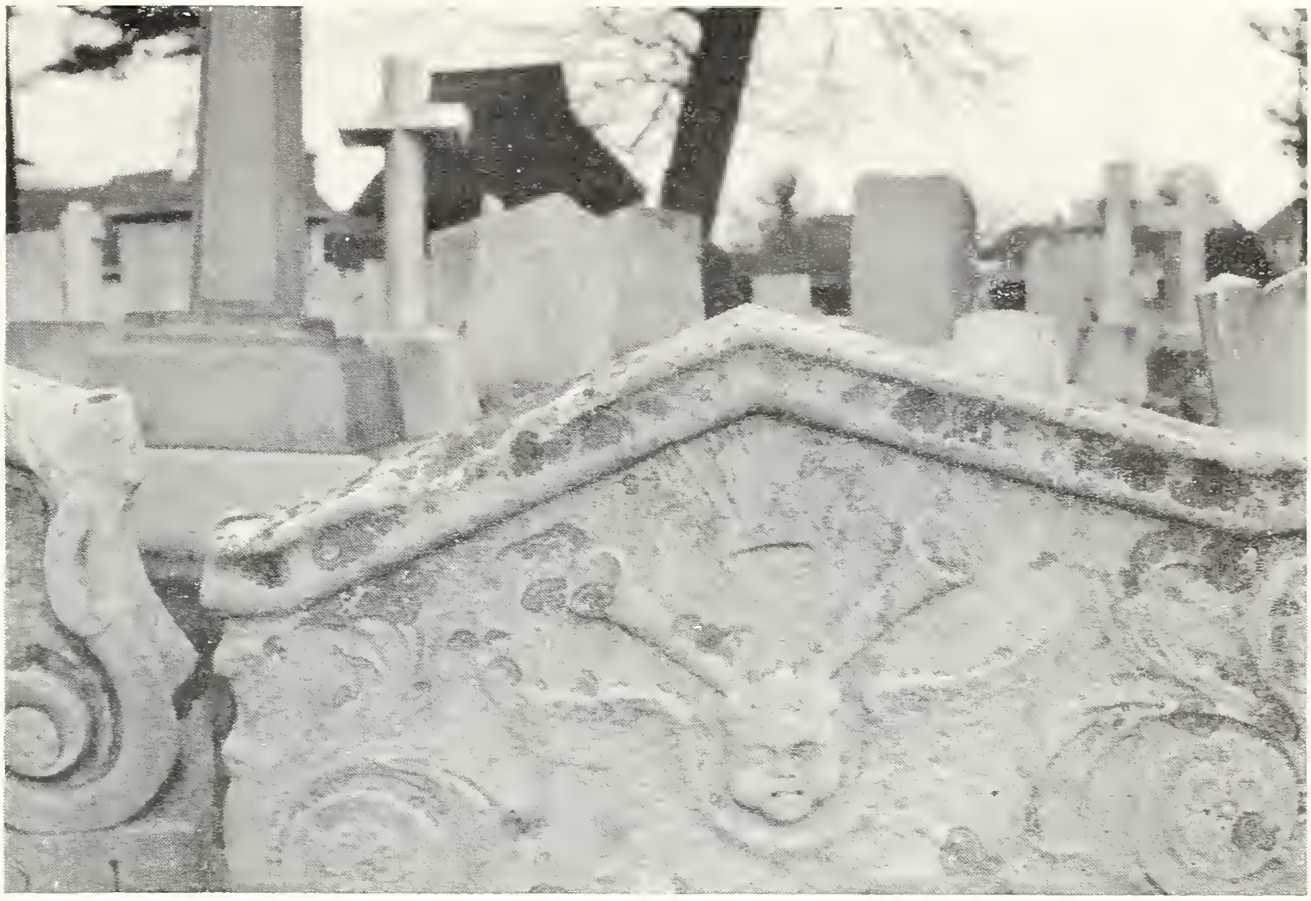

PLATE 1. *Caloplaca heppiana* growing on an 18th century headstone in St. Lawrence's churchyard, Morden (London Borough of Merton). The oldest limestone memorials in a churchyard usually have the best developed lichen vegetation. Many of the memorials in this picture are scheduled for clearance. 1969. *J.R.L.*

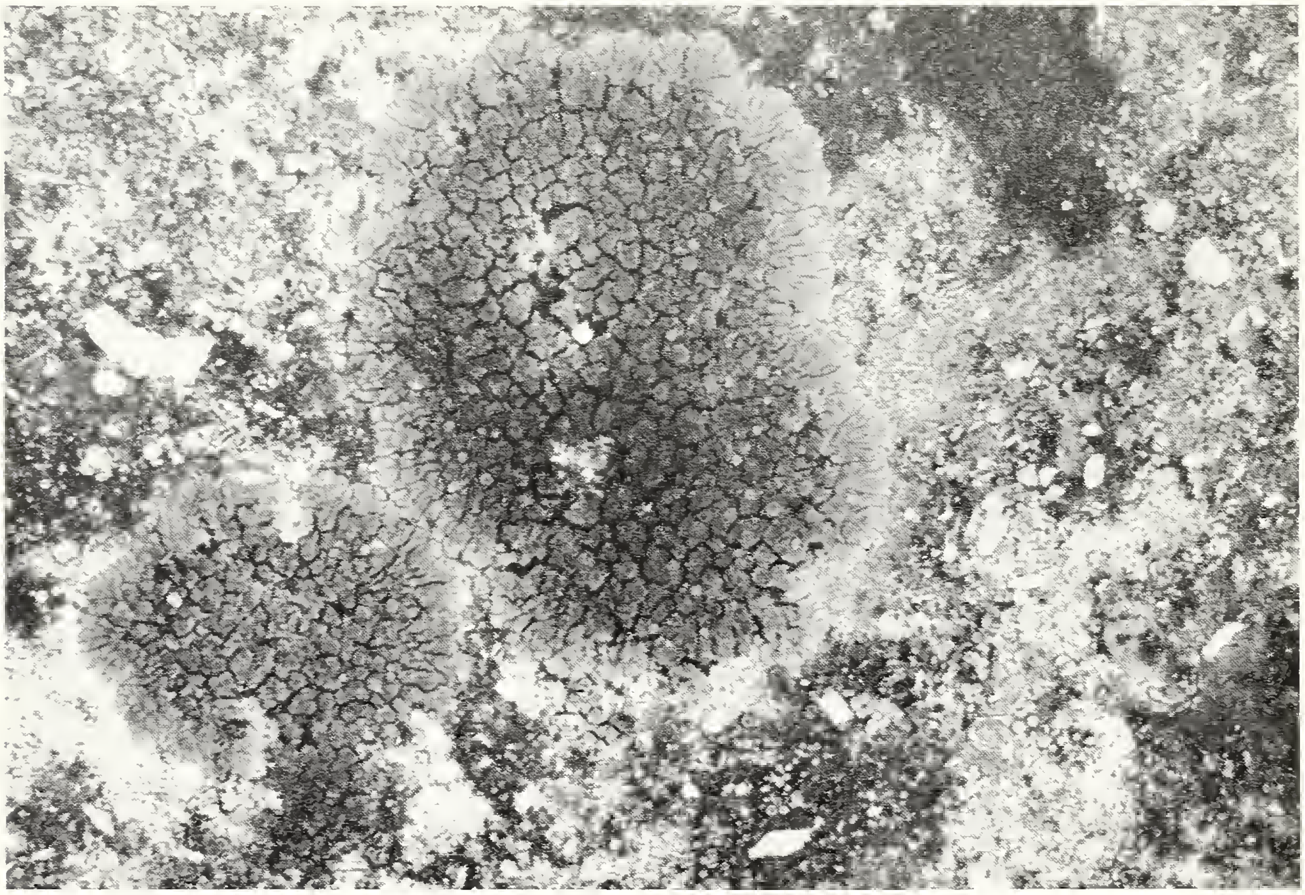

PLATE 2. Thalli of *Caloplaca heppiana* on the horizontal limestone top of a chest-tomb (179–) in St. Peter and St. Paul's churchyard, Mitcham (London Borough of Merton). Small apothecia of *Lecanora dispersa* surround the *Caloplaca*. 1969. *J.R.L.*

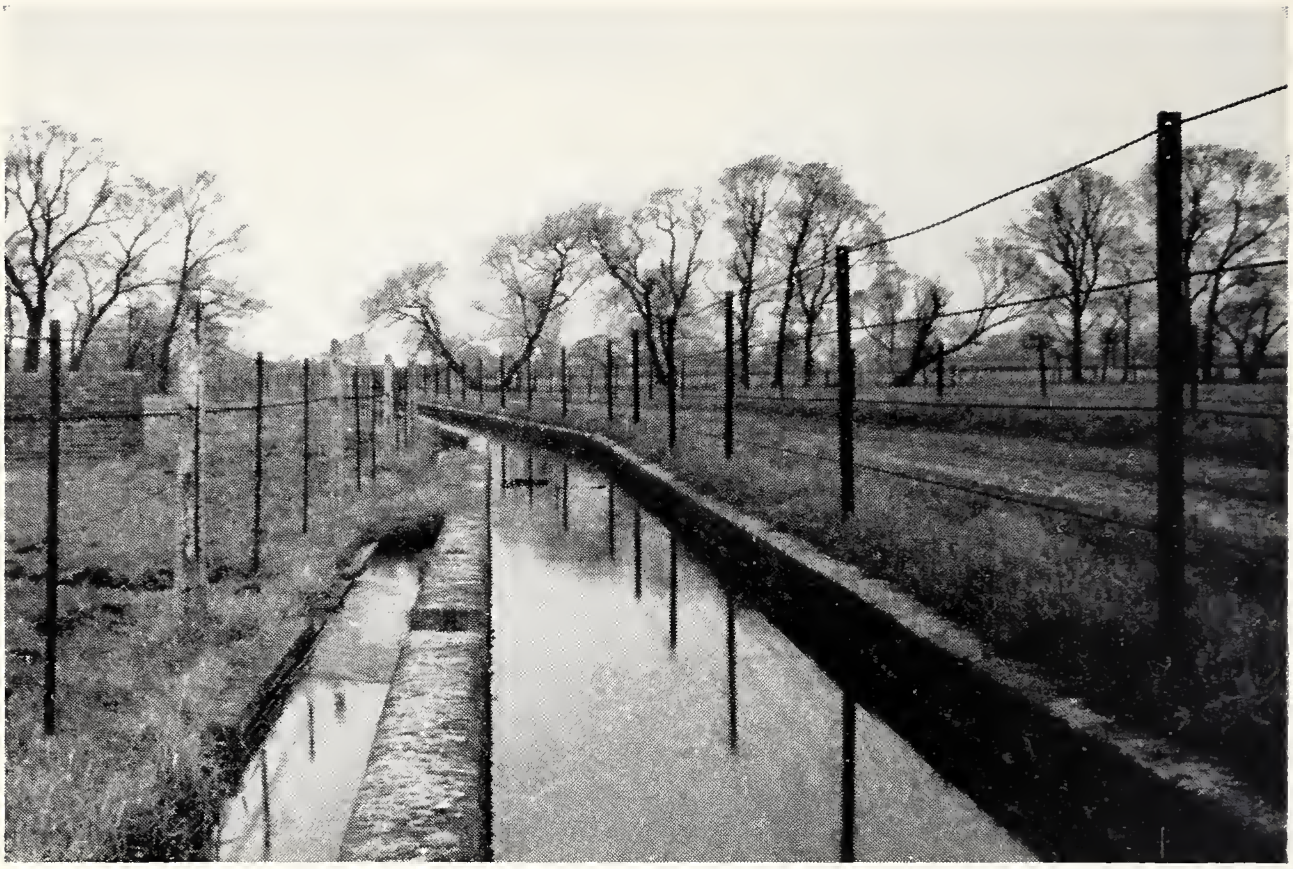

Plate 3. White mats of *Physcia caesia* on the concrete tops of effluent channels at Beddington Sewage Farm (London Borough of Sutton). These irrigation fields and channels are shortly to be destroyed, and the M23 motorway is to cut through the trees in the centre of the picture. 1969. *J.R.L.*

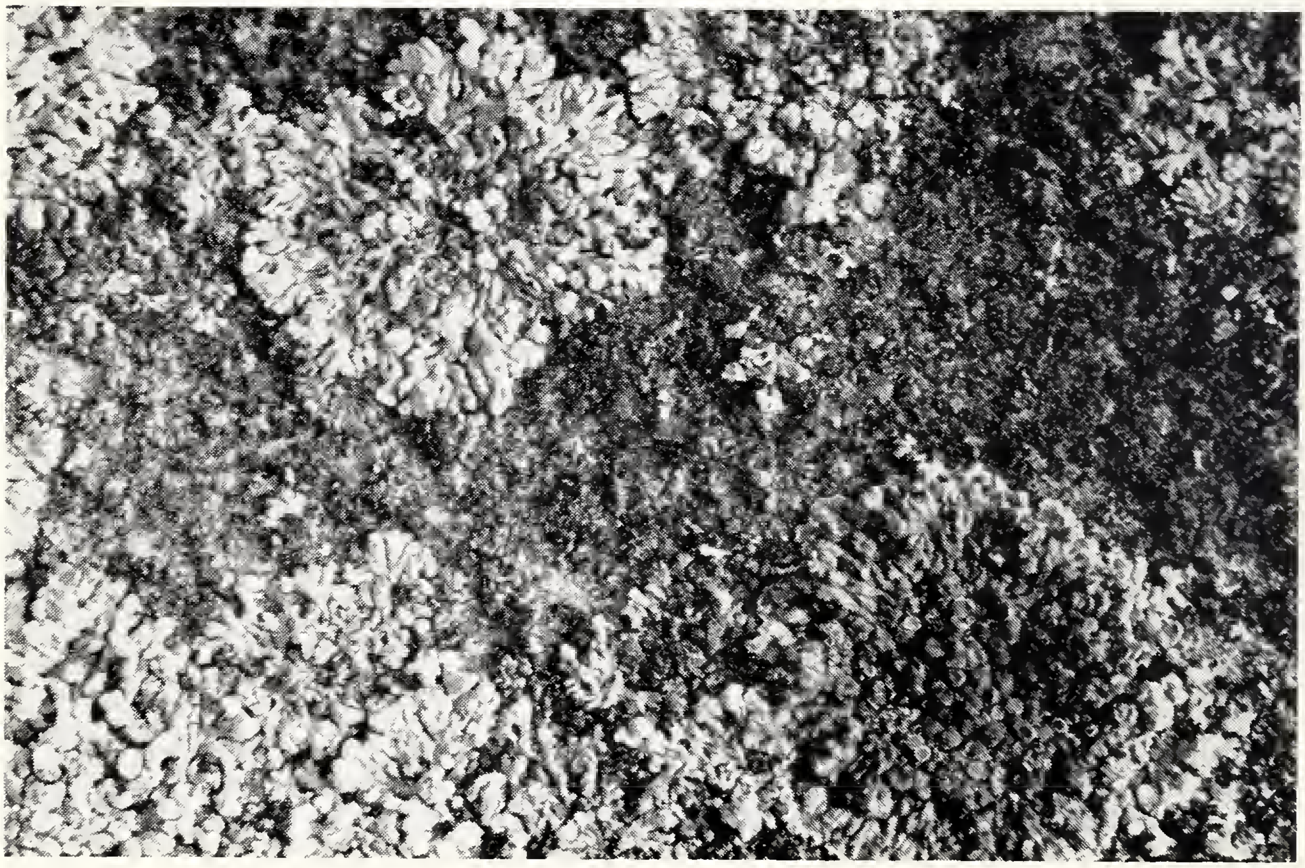

Plate 4. Thalli of *Physcia caesia* (top, and bottom left) and *Lecanora muralis* (bottom right) on the channels at Beddington Sewage Farm. 1969. *J.R.L.*

to the sky, and surrounded by low brick walls. Since 1954 rebuilding, chiefly of office blocks, has been carried out on the bombed sites so that only a few now survive. The sites were quickly colonised by plants, but only one lichen (1%), *Lecanora dispersa*, has been found in this habitat. By 1954 this species was abundant on almost all calcareous substrata on the most extensive of the sites at Cripplegate (City), and was also common on other bombed sites in Central London. *L. dispersa* is now uncommon again in these areas because its habitats have been destroyed by building operations. Extensive searches on several bombed sites failed to reveal any species of *Cladonia*, or indeed any terricolous lichen, probably because of the air pollution, although the lack of established acid humus is possibly also a contributory factor.

CONSERVATION

The extinction of at least 57% of London's lichens demonstrates the way in which urbanisation is harmful to lichens. Most extinctions have resulted from the increase in the amount of sulphur dioxide pollution in the air, so that for lichen conservation to be effective the concentration must be reduced. Though London smoke ground-level concentrations are declining, sulphur dioxide shows little decrease. Unfortunately, sulphur dioxide is very difficult to eliminate in comparison with smoke, grit and dust. The problems involved are discussed by the National Society for Clean Air (1964), who conclude "that there is no prospect in the immediate future of entirely eliminating this gas, but that . . . much can be done to reduce the total emissions and to reduce its concentration in the air". One of the important methods of reducing its concentration is to discharge the sulphur dioxide at a very high level, so that with the combination of a tall chimney, a high velocity of discharge, and the buoyancy of a hot plume, the gases will rise to 300-600 metres in favourable conditions and disperse in a manner which contributes little to the pollution at ground level. The report suggests, along with other contributory solutions, that in towns district-heating should be adopted, with pollution discharged through a single high chimney instead of from numerous low domestic chimneys as at present. The policy of discharging harmful gases at high levels away from urban development results in less pollution affecting towns than would otherwise be the case, but the resulting wider dispersal of sulphur dioxide may prove harmful to lichens in rural areas with comparatively clean air at present.

Surviving semi-natural vegetation in London should be conserved to prevent further losses to the lichen flora, and indeed to conserve other groups of plants and animals. In woods the retention of the shrub layer is important for this provides shelter and so increases atmospheric humidity, thus lowering evaporation rates. *Lecanora conizaeoides* extends high up the boles in London woods with a well-developed shrub layer, and occasionally additional lichens are present, but in woods in which the shrub layer has been removed (as in that bordering Greenwrythe Lane, Sutton) *L. conizaeoides* is chiefly restricted to the tree bases and other lichens are absent.

The terricolous lichen flora on the semi-natural heathland in south-west London is of special interest and the preservation of the heaths and commons therefore essential. Excessive trampling and mowing, and the widespread use of chemical fertilisers and herbicides, accounts for the disappearance of much heathland flora. Light trampling, as occurs at

Putney Heath, is favourable, for open communities are maintained in which the lichens are not crowded out by aggressive plants, and lichen thalli are dispersed by fragmentation. Too many open spaces have been converted to lawns and playing fields, with the result that terricolous lichens are eliminated. Syon House Gardens provide an excellent example of the way in which interesting lichen areas are destroyed by the promoters of tidiness and formality. Before 1966 these Gardens were informal, very picturesque and rather neglected, with *Cladonia chlorophaea*, *C. coniocraea*, *C. furcata* and *C. pyxidata* growing on old gravel paths and amongst moss on the lawns, a mat of *Physcia caesia* covering part of the limestone edge of a small ornamental pond, and *Caloplaca aurantia*, *C. heppiana* and *Candelariella medians* growing on the basal plinth of a limestone column. During 1966 and 1967 Imperial Chemical Industries and the Duke of Northumberland spent £500,000 in converting the Gardens into a commercial venture called "The Gardening Centre". The Gardens were completely re-laid in the process of which the old gravel paths were destroyed and replaced with new re-routed gravel paths, and the lawns were replanted. Terricolous lichens are now absent from both the paths and the lawns because of the treatment with weed-killing chemicals, the edge of the pond has been cleaned bare of *Physcia* and a climbing *Hedera* has been planted to cover the basal plinth of the column, which has also been encircled with young shrubs of *Rhododendron*, so that the lichen flora of the plinth will be exterminated by increased shade. Thus the lichenological interest in the Gardens will soon entirely disappear. Probably the main threat to London's open spaces today lies in the construction of new roads and motorways, including the controversial Motorway Box. Osterley Park has already been sliced by the South Wales Motorway (M4), and such interesting areas as Barnes Common, Beddington Sewage Farm (Plate 3), Mitcham Common and Morden Hall Park are threatened with comparable works of engineering. When new roads are constructed, the disturbance to vegetation and amenity values must be kept to a minimum.

Surviving artificial habitats rich in lichens also merit conservation. Old churchyards have far more lichens than any other habitat, including important relict species, and therefore the more interesting are worthy of preservation. Despite the attractive appearance of their rows of fine headstones (Plate 1) there is always the possibility that the memorials may be cleared and the ground converted into public gardens, so that the lichen flora is unwittingly destroyed. Increased labour costs, unkept graves resulting from greater mobility of population, overcrowding and untidiness are reasons cited for this policy. Fortunately most old London churchyards in the Suburban Ring are well maintained and of attractive appearance at present, and are in no immediate danger. An exception is St. Lawrence, Morden (Plate 1), where the headstones, some of which date from the 18th century and have an interesting lichen vegetation, are scheduled for clearance. Negotiations have fortunately resulted in several memorials being listed for preservation *in situ* on historical and scientific grounds. In both Central London and the Inner Urban Ring many old churchyards and cemeteries have been cleared and converted to lawns or public gardens, chiefly to "tidy them up" and to increase their amenity value because of the lack of other open spaces. However, some of the oldest picturesque memorials, especially chest-tombs, are frequently retained *in situ*, as at St. Andrew's Gardens, Wren Street, and St. Pancras Gardens, Pancras Road, both in Camden. Since these memorials are generally amongst the best lichen habitats, such partial clearances are not wholly detrimental. Recent limestone memorials in London are very poor in lichens and therefore the current fashion in cemeteries for polished marble and polished granite, instead of limestone, and the practice of cremation since 1885, is of little importance for restricting lichen habitats.

Sewage farms using irrigation methods are being closed down or modernised. South Norwood Sewage Farm is in process of closure and Beddington Sewage Farm (Plate 3) is undergoing modernisation. At both Farms the concrete channels linking the irrigation fields will be demolished, and at Beddington the old channels on the site of the new works were destroyed in 1966. South Norwood Sewage Farm has a poor lichen flora, but that at Beddington is very rich (Plate 4) and important, despite the air pollution from the adjacent Waddon Marsh Power Station, built in 1950. The lichen flora of old sewage farms should be studied and recorded in literature before it is too late.

Restoration is frequently detrimental to lichen vegetation. At Elmstead Woods Station, Bromley, there was a rich growth of mosses and lichens on an old brick wall in 1956, with many plants of *Cladonia macilenta*, *Physcia adscendens* and *Xanthoria parietina* sensu lato. By 1964 the wall had been repaired and cleaned of mosses and lichens. Only a few squamules of *Cladonia macilenta*, one minute thallus of *Physcia adscendens* and a few small thalli of *Xanthoria* survive, all chiefly in small depressions. It would appear that the wall surface will eventually be recolonised from these remaining plants.

Lichens are slow growing and their relict nature in urban areas makes some of them susceptible to extinction through over-collecting. It is therefore perhaps fortunate that collecting is often prevented because of the risk of damaging surfaces. When a danger of extermination is apparent or the nature of the substratum prevents the use of normal collecting methods, a few apothecia or thallus fragments should be carefully removed into a small paper capsule, and a permanent microscope slide made therefrom to serve as a permanent record.

Although urbanisation is renown for destroying lichen vegetation, it is not harmful to all lichens. *Lecanora conizaeoides* requires moderate air pollution to be able to flourish (see Laundon, 1967, p. 292) and is therefore restricted to the more densely populated parts of Europe. The abundance of artificial calcareous substrata, in the form of concrete, cement, and asbestos-cement roofing, has provided extensive habitats for fast-growing pioneer crustaceous and squamulose lichens, with the result that *Candelariella aurella*, *Lecania erysibe*, *Lecanora dispersa*, *L. muralis* and *Rinodina subexigua* are more common in the Suburban Ring than in the Green Belt beyond. Planning controls, clean air policy, and the preservation of areas of vegetation for their amenity, recreational and scientific value should ensure that lichen communities will be less harmed in future town development than they have been in the past.

LICHEN FLORA

The species are arranged alphabetically and the nomenclature is based on James (1965; 1966), with later corrections. All old and contemporary records are included, with synonymy relating to the former. Species not seen in recent years in the Area are generally considered to be extinct and are therefore placed in square brackets ([ ]). Nitrophilous species are noted, and those not so indicated are either nitrophobous or nitrotolerant. Nitrophilous lichens are those that are confined to habitats rich in nitrogeneous matter, but so far "there is no good experimental evidence to show whether the distribution of such lichens is dependent upon nitrogen supplies or upon some factor" (D. C. Smith, 1962, p. 550).

The records are arranged under the Greater London boroughs, which replaced the older smaller units for administrative purposes on April 1, 1965. The boroughs are denoted by their official numbers, printed in bold type, which are as follows:

1. City of Westminster
2. Camden
3. Islington
4. Hackney
5. Tower Hamlets
6. Greenwich
7. Lewisham
8. Southwark
9. Lambeth
10. Wandsworth
11. Hammersmith
12. Kensington and Chelsea
13. Waltham Forest
14. Redbridge
15. Havering
16. Barking
17. Newham
18. Bexley
19. Bromley
20. Croydon
21. Sutton
22. Merton
23. Kingston upon Thames
24. Richmond upon Thames
25. Hounslow
26. Hillingdon
27. Ealing
28. Brent
29. Harrow
30. Barnet
31. Haringey
32. Enfield

A map of the boroughs appears in Fig. 1. Boroughs **15** and **26** are outside the Area, and **18** almost entirely so, and therefore these three do not appear in the records. Vaguely localised records are shown with the respective boroughs separated by an oblique stroke (/). In places where a single locality is dissected by a borough boundary (*e.g.* Beddington and South Norwood Sewage Farms), care has been taken to ensure that the records are correctly placed. The City of London forms a separate administrative unit, and its single lichen record is placed under **"CITY"**. The vice-county system has not been used since it divides London into artificial segments which distract from considering the urban area as a single unit. Grid squares have been used only to map distribution (Fig. 2), because the squares do not fit well into the circular Area.

The records are of three kinds: herbarium, literature and field, and they are generally quoted in that order of priority. Thus if both an institutional herbarium specimen and literature reference are available for a particular record, only the herbarium specimen is cited, this being the more important since it can be verified. All herbarium material quoted has been examined and checked. International abbreviations for herbaria are as follows: BM (British Museum (Natural History), London), IMI (Commonwealth Mycological Institute, Kew), K (Herbarium, Royal Botanic Gardens, Kew), LD (Lund, Sweden), LINN (Linnean Society, London), OXF (Department of Botany, Oxford University). All literature records have been checked and only the earliest reference is generally given, since later authors frequently repeated records without mentioning their source. Field records are denoted by the absence of a herbarium or literature citation following the observer's name. Surnames only are given for the contributors listed below. Where no field observer is given the records are my own.

The main contributors to the lichen flora are listed below, with dates of birth and death in parenthesis.

BRIGHTMAN, FRANK HATTON (1921-). Contributed records and an ecological study (Brightman, 1959) from south-east London.

BUDDLE, REVEREND ADAM (*c.* 1660-1715). Undated Hampstead lichens in the Sloane Herbarium (BM).

CROMBIE, REVEREND JAMES MORRISON (1830-1906). Collected lichens in Middlesex (now north-west London), chiefly from 1870-1873 (BM). Published an important paper (Crombie, 1885) on the diminution of lichens in Epping Forest.

DARBISHIRE, OTTO VERNON (1870-1934). Published a list of lichens found in the Royal Botanic Gardens, Kew (Darbishire, 1906).

DILLENIUS, JOHN JACOB (1684-1747). Collected lichens from the Area after 1721. For a discussion of his specimens at Oxford see Laundon (1967, pp. 304-305).

EDWARDS, PETER JOHN (1947-). Collected lichens from asbestos—cement roofs at Kew and Perivale, 1967-68.

FORSTER, EDWARD (1765-1849). Collected lichens from Walthamstow and neighbourhood probably between 1784 and 1812 (BM). For a discussion of the dating of his collection and the collecting localities see Laundon (1967, pp. 305-306). It should be noted that some punctuation and capital letters have occasionally been added in this paper to the quotations of the localities on Forster's herbarium labels because of deciphering difficulties and in order to render the records comprehensible. His notebooks, cited as "MSS.", are in the Botanical Library of the British Museum (Natural History).

GILBERT, JOHN LESTER (1920-). Collected lichens from Richmond Park, Royal Botanic Gardens, Kew, and adjacent areas, from 1956 onwards.

LAUNDON, JACK RODNEY (1934-). Began work in 1956 on a study of the lichen flora of London in relation to the urban environment. The results are published in Laundon (1967) and in this present work.

MILNE, ANTHONY RUSSELL (1923-). Collected lichens from Blackheath in 1968.

SUMMERHAYES, VICTOR SAMUEL (1897-). Organised a committee to conduct a "Botanical Survey of Richmond Park" in 1929 which resulted in the collecting and recording of lichens from the Park and Ham Common. For further details see Laundon (1967, p. 306).

WALLACE, NANCY (1907-). Contributed records chiefly from Croydon in 1967-68.

The old records from London are particularly interesting for demonstrating the richness of the epiphytic lichen flora of the southern end of Epping Forest prior to the spread of air pollution. As regards individual species, the old records of *Cladonia capitata*, *C. convoluta* and *Teloschistes flavicans* are important for their localised distribution. The more interesting lichens which may still be seen in London include *Bacidia chlorococca* *B. herbarum*, *Cladonia crispata*, *Cornicularia aculeata*, *Physcia nigricans*, *Stereocaulon nanodes*, *S. pileatum*, and *Verrucaria viridula* forma *tectorum*.

Introduced lichens (see Laundon, 1967, pp. 301-302) are not considered in this paper, nor are the species previously excluded by me (Laundon, 1967, p. 325) from the London flora.

Acarospora fuscata (Nyl.) Arnold
  Acid stone. Rare.
  20: Shirley, Cheston Avenue, abundant on crumbling brick walls, 1967, *Wallace* (BM); The Glade, 1967, *Wallace*.

[*Anaptychia ciliaris* (L.) Körb.
  Bark. Nitrophilous. Probably became extinct in the first half of the 19th century.
  9/10 :Tooting Common, herb. *J. F. Young* (BM). **13:** Walthamstow, *Forster* (BM).]

[*Arthonia radiata* (Pers.) Ach. (*A. astroidea* Ach.; *A. swartziana* Ach.; *Opegrapha swartziana* (Ach.) Hepp)
  Bark.
  13: Walthamstow, "in garden, Hoe Street", *Forster* (BM); "between Hale End & Chapel End", *Forster* (BM).]

[*Arthopyrenia alba* (Schrad.) Zahlbr. (*Acrocordia gemmata* (Ach.) Massal.; *Arthopyrenia gemmata* (Ach.) Massal.; *Lichen gemmatus* Ach.; *Verrucaria gemmata* (Ach.) Ach.)
  Bark.
  13: Walthamstow, "on the Forest near Hale brinks", *Forster* (BM).]

[*A. biformis* (Borr.) Massal. (*Acrocordia biformis* (Borr.) Arnold; *Verrucaria biformis* Borr.)
  Bark.
  13: Walthamstow, "on a tree in Mark house field", *Forster* (BM).]

[*A. punctiformis* (Pers.) Massal. (*A. analepta* Massal.; *Verrucaria epidermidis* var. *analepta* Hook.)
  Smooth bark.
  13: Walthamstow, "on a tree in field near Hoe Street adjoining Bury fields", *Forster* (BM).]

Bacidia chlorococca (Stiz.) Lettau
  Bark. Rare.
  25: Osterley Park, nat. grid TQ 147785, on *Salix* by lakeside, 1965, *Laundon* 2492 (BM).

B. herbarum (Stiz.) Arnold
  Calcareous stone. Rare.
  22: Mitcham Watermeads, scarce on mortar of top of brick channel wall by small weir, 1966, *Laundon* 2602 (BM, slide coll.).

B. sabuletorum (Schreb.) Lett. (*Bilimbia sabuletorum* (Schreb.) Arnold)
  Mosses on calcareous stone. Rare.
  30: Totteridge, St. Andrew's churchyard, scarce on moss on limestone chest-tomb, 1964, *Laundon* 2471 (BM).

B. umbrina (Ach.) Bausch
  Acid stone. Rare.
  20: Shirley, Cheston Avenue, 1967, *Wallace*. **22:** Mitcham Watermeads, on brick weir, 1966, *Laundon* 2603 (BM, slide coll.).

[*Baeomyces roseus* Pers. (*Lichen ericetorum* sensu Forster, non L.)
  Sandy acid soil with little or no humus development.
  13: Leyton, "On the Forest near Layspring", *Forster* MSS.]

[*B. rufus* (Huds.) Rebent.
  Sandy acid soil with little or no humus development.

31: "Hornsey Wood", *J. E. Smith* (BM).]

[*Biatorella moriformis* (Ach.) Th. Fr. (*Lecidea tantilla* Nyl.)
Wood.
13: Walthamstow, "pales at Hoe Street", *Forster* in Crombie (1885, p. 66). **30:** "On old pales near Hendon", 1870, *Crombie* (BM); "On old pales near Millhill", 1872, *Crombie* (BM).]

[*Buellia alboatra* (Hoffm.) Branth & Rostr. (*Lecidea alboatra* var. *epipolia* (Ach.) Schaer.; *Rhizocarpon alboatrum* var. *epipolium* (Ach.) Anzi)
Calcareous stone. Nitrophilous.
13: Walthamstow, walls, *Forster* (BM).]

B. canescens (Dicks.) De Not.
Stone; formerly also on bark. Nitrophilous. Now rare.
13: Walthamstow, on bark, *Forster* (BM); "on an apple tree in garden, Hoe Street", *Forster* (BM, with *Physciopsis adglutinata*); "field in Hoe Street", *Forster* (BM, with *Buellia punctata*); "in a wood, near Hale End", *Forster* (BM, with *Candelariella xanthostigma*). **21:** Beddington, Church Lane, two plants on brick and mortar in crevice of old brick wall, 1967-68. **30:** Hendon, on *Ulmus*, *Crombie* (BM).

B. punctata (Hoffm.) Massal. (*B. myriocarpa* (DC.) De Not.; *Lecidea myriocarpa* (DC.) Röhl.; *Lichen pinicola* Ach.)
Bark and wood. Nitrophilous. Now rare.
1: Kensington Gardens, 1802, Herb. *J. E. Smith* misc. lich. coll. (LINN). **2:** "on the firs, Hampstead Heath", *Crombie* (BM). **11:** "on an old elm at Hammersmith—on the banks of the Thames. 1877", *Larbalestier* (BM). **13:** Walthamstow, *D. Turner* (BM); "on pales, Hoe Street", *Forster* (BM); "field in Hoe Street", *Forster* (BM); "elms at Higham Lodge", *Turner* in Turner & Dillwyn (1805, p. 289). **21:** Beddington Sewage Farm, abundant on south sides of several *Ulmus* trees, 1963, *Laundon* 2395 (BM). **24:** "Richmond Park", *Crombie* (BM). **30:** Finchley, "on old pales. 1872", *Crombie* (BM).

[*Calicium abietinum* Pers. (*C. curtum* Turn. & Borr. ex Sm.)
Wood and decaying bark.
13: Walthamstow, "on garden pales in Hoe Street", *Forster* (BM). **27:** Ealing, *Crombie* in Trimen & Dyer (1869, p. 406). **30:** near Totteridge, *Crombie* (*loc. cit.*).]

[*C. salicinum* Pers. (?*C. sphaerocephalum* (L.) Ach;*C. trachelinum* Ach.)
Decayed bark.
13: Leyton, "tree in the Lea Bridge Road", *Forster* (BM).]

Caloplaca aurantia (Pers.) Hellb.
Calcareous stone. Nitrophilous. Rare.
10: Tooting, St. Nicholas's churchyard, several plants on Atkins chest-tomb, 1968. **21:** Beddington, St. Mary's churchyard, two plants on chest-tomb to Robin Betterton (1724), 1961-64. **25:** Syon House Gardens, two plants on north side of plinth of column, 1964-68.

[*C. cerina* (Ehrh. ex Hedw.) Th. Fr. (*Lecanora cerina* (Ehrh. ex Hedw.) Ach.)
Bark. Nitrophilous.
"Trunks of trees . . . near London", *Hooker* (1833, p. 190).]

C. citrina (Hoffm.)Th.Fr. (*C. phlogina* (Ach.)Flag.)
Calcareous stone. Nitrophilous. Frequent in the Suburban Ring, especially on walls, paths, churchyard memorials, etc.
Inner records: **1:** Kensington Gardens, frequent on limestone edge of

ponds at The Fountains, 1964; Regent's Park, The Holme, on stone vase, 1967. Also recorded from **2, 6, 7, 9-11, 13, 14, 16, 19-22, 24, 25, 27-32.**

Both yellow and orange forms occur in London.

C. decipiens (Arnold) Jatta

Calcareous stone. Nitrophilous. Scarce.

10: Tooting, St. Nicholas's churchyard, occasional on chest-tombs, 1968. **19:** Elmstead Woods Station, three small plants on mortar of brick wall, 1964; South Norwood Sewage Farm, scarce on concrete, 1963, *Laundon* 2394 (BM). **20:** Shirley, Bennett's Way and West Way, 1967-68, *Wallace.* **21:** Beddington, St. Mary's churchyard, occasional, 1961-64; Beddington Sewage Farm, occasional on concrete channels and bacteria beds, 1962-68; Sutton, Benhilton, All Saints' churchyard, scarce, 1965. **24:** Kew, St. Anne's churchyard, on chest-tomb, 1969. **31:** Tottenham, All Hallows' churchyard, on chest-tomb, 1968.

C. heppiana (Müll.Arg.) Zahlbr. (*Placodium murorum* auct. pro parte, non (Ach.)DC.)

Calcareous stone. Nitrophilous. Occasional, especially on churchyard memorials. For distribution map see Fig. 2B.

2: Hampstead, St. John's churchyard, scarce, 1965. **6:** Blackheath, St. Michael's churchyard, on limestone wall, 1968, *Milne* (Herb. Milne). **7:** Lee Terrace, St. Margaret's churchyard, on several tombs, 1968, *Milne;* Lewisham High Street, St. Mary's churchyard, several plants, 1968. **9:** Streatham, St. Leonard's churchyard, on two memorials, 1968. **10:** Tooting, St. Nicholas's churchyard, frequent, 1968. **11:** Fulham, All Saint's churchyard, several plants on four chest-tombs, 1968. **13:** Walthamstow, St. Mary's churchyard, occasional, 1967. **14:** Wanstead, St. Mary's churchyard, frequent, 1963; Woodford, St. Mary the Virgin's churchyard, scarce, 1967. **19:** Beckenham, St. George's churchyard, frequent, 1968. **20:** South Croydon, St. Peter's churchyard wall, one plant, 1968, *Wallace.* **21:** Beddington, Church Lane, several plants on mortar of old brick wall, 1958-68; Beddington, St. Mary's churchyard, frequent, 1961-64; Carshalton, All Saint's churchyard, common, 1965; Sutton, Benhilton, All Saints' churchyard, scarce, 1965. **22:** Merton, St. Mary's churchyard, occasional, 1961-64; Mitcham, Bishopsford Road, on wall of Wandle bridge, 1961-64; Mitcham, St. Peter and St. Paul's churchyard, frequent, 1961-69; Morden Hall Park, on two plinths, 1961-64; Morden, St. Lawrence's churchyard, frequent, 1961-69; Wimbledon, St. Mary's churchyard, occasional, 1962. **24:** Barnes, St. Mary's churchyard, three plants, 1968; Kew, Royal Botanic Gardens, *Darbishire* (1906, p. 103), probably this species; Petersham, St. Peter's churchyard, abundant, 1968; Twickenham, St. Mary's churchyard, frequent, 1966. **25:** Chiswick Old Burial Ground, occasional, 1964; Syon House Gardens, occasional on plinth of column, 1958-68. **27:** Greenford, Holy Cross churchyard, frequent, 1967; Hanwell, St. Mary's churchyard, frequent, 1967; Perivale churchyard, four plants, 1966. **28:** Kingsbury, St. Andrew's churchyard, on three chest-tombs, 1967; Willesden, Neasden Lane, St. Mary's churchyard, on chest-tomb, 1968. **29:** Little Stanmore, St. Lawrence's churchyard, frequent, 1965. **30:** East Barnet, St.

Mary the Virgin's churchyard, occasional, 1968; Hendon, St. Mary Magdalene's churchyard, abundant, 1968; Totteridge, St. Andrew's churchyard, abundant, 1957-64. **31:** Hornsey, St. Mary's churchyard, several plants on one chest-tomb, 1968; Tottenham, All Hallows' churchyard, occasional, 1968. **32:** Cockfosters, Christ Church churchyard, on two headstones, 1968; Edmonton, All Saints' churchyard, frequent, 1968; Southgate, Christ Church churchyard, on two memorials, 1968.

C. holocarpa (Hoffm.) Wade (*C. pyracea* (Ach.) Th. Fr.)

Confined to the tops of old limestone chest-tombs in churchyards. Nitrophilous. Scarce.

21: Beddington, St. Mary's churchyard, scarce, 1961. **22:** Wimbledon, St. Mary's churchyard, scarce, 1956-64. **25:** Chiswick Old Burial Ground, frequent on east side, 1964. **29:** Little Stanmore, St. Lawrence's churchyard, scarce, 1965. **30:** Totteridge, St. Andrew's churchyard, common on one tomb, 1964.

[*C. luteoalba* (Turn)Th.Fr. (*Lichen luteoalbus* Turn.)

Bark. Nitrophilous.

13: Walthamstow, "ash tree, forest near Hale End", *Forster* (BM); "in garden Hoe Street", *Forster* MSS. **20:** "growing plentifully on lime trees at Croydon" *Turner* (1804, p. 94). **30:** near Mill Hill, *Crombie* (BM).]

C. murorum (Ach.) Th. Fr.

Calcareous stone. Nitrophilous. Rare.

21: Beddington Sewage Farm, several plants on bacteria beds, 1966, *Laundon* 2519 (BM). **22:** Beddington Sewage Farm, on concrete channels in Hundred Acre Lane, 1966.

C. teicholyta (Ach.)Steiner (*C. arenaria* auct., non (Pers.)Müll.Arg.; *C. erythrocarpa* auct., non (Pers.)Zwackh)

Calcareous stone. Nitrophilous. Occasional, chiefly in churchyards where it usually occurs on only a single chest-tomb.

9: Streatham, St. Leonard's churchyard, on chest-tomb, 1968. **10:** Tooting, St. Nicholas's churchyard, several plants, 1968. **11:** Fulham, All Saint's churchyard, on chest-tomb, 1968. **13:** Walthamstow, St. Mary's churchyard, on chest-tomb, 1967. **16:** Barking, St. Margaret's churchyard, on chest-tomb, 1967. **19:** Elmstead Woods Station, two plants on mortar of brick wall, 1964. **21:** Beddington, Church Lane, scarce on mortar of old brick wall, 1958-68. **22:** Mitcham, St. Peter and St. Paul's churchyard, several plants on chest-tomb, 1964; Morden, St. Lawrence's churchyard, several plants, 1961-65. **24:** Kew, St. Anne's churchyard, on chest-tomb, 1968; Petersham, St. Peter's churchyard, a few plants on a slab, 1968. **27:** Greenford, Holy Cross churchyard, on chest-tomb, 1967; Hanwell, St. Mary's churchyard, on chest-tomb, 1967. **30:** Totteridge, St. Andrew's churchyard, occasional, 1957-64. **32:** Cockfosters, Christ Church churchyard, on chest-tomb, 1968.

[*Candelaria concolor* (Dicks.) Stein

Bark. Nitrophilous.

13: Walthamstow, "on trees", *Forster* (BM).]

Candelariella aurella (Hoffm.)Zahlbr. (*Caloplaca epixantha* auct., non (Ach.)Flag.; *Candelariella vitellina* sensu Brightman (1959), non (Hoffm.)Müll.Arg.)

Calcareous stone. Nitrophilous. Common in the outer suburban areas.

Inner record: **2:** St. Pancras, Wren Street, St. Andrew's Gardens, one plant on chest-tomb, 1967. Also recorded from **1, 4-14, 16, 17, 19-25, 27-32.**

C. medians (Nyl.)A.L.Sm.

Calcareous stone. Nitrophilous. Local, chiefly on churchyard memorials, where it is usually the most common squamulose lichen. For distribution map see Fig. 2A.

1: Kensington Gardens, locally abundant on south-east wall of The Fountains, 1961-67. **2:** Hampstead, St. John's churchyard, frequent, 1965. **6:** Blackheath, St. Michael's churchyard, 1968, *Milne;* Charlton, St. Luke's churchyard, occasional, 1968. **7:** Lee Terrace, St. Margaret's churchyard, 1968, *Milne;* Lewisham High Street, St. Mary's churchyard, frequent, 1968. **9:** Streatham, St. Leonard's churchyard, on one headstone, 1961-68. **10:** Tooting, St. Nicholas's churchyard, scarce, 1968. **11:** Fulham, All Saints' churchyard, frequent, 1968. **13:** Leyton, St. Mary the Virgin's churchyard, on two headstones, 1969; Walthamstow, St. Mary's churchyard, frequent, 1967. **14:** Wanstead, St. Mary's churchyard, frequent, 1963; Woodford, St. Mary the Virgin's churchyard, frequent, 1967. **16:** Barking, St. Margaret's churchyard, abundant on chest-tombs at west end, 1967. **17:** East Ham, High Street South, St. Mary Magdalene's churchyard, on headstone, 1969. **19:** Beckenham, St. George's churchyard, frequent, 1968; Bromley, St. Peter and St. Paul's churchyard, on one stone, 1963. **21:** Beddington, St. Mary's churchyard, abundant, 1961-68; Beddington Sewage Farm, local on channels and bacteria beds, 1962-69; Carshalton, All Saints' churchyard, common, 1965. **22:** Merton, St. Mary's churchyard, frequent, 1961-64; Mitcham, St. Peter and St. Paul's churchyard, occasional, 1962-64; Morden, St. Lawrence's churchyard, frequent, 1962-69; Wimbledon, St. Mary's churchyard, frequent, 1962-64. **24:** Kew, St. Anne's churchyard, occasional, 1957-68; Petersham, St. Peter's churchyard, occasional, 1968; Twickenham, St. Mary's churchyard, frequent, 1966. **25:** Chiswick Old Burial Ground, occasional, 1964; Isleworth, All Saints' churchyard, frequent, 1966; Syon House Gardens, on urn and plinth of column, 1958-68. **27:** Greenford, Holy Cross churchyard, frequent, 1967; Hanwell, St. Mary's churchyard, occasional, 1967. **28:** Kingsbury, St. Andrew's churchyard, several plants, 1967; Willesden, Neasden Lane, St. Mary's churchyard, on two memorials, 1968. **29:** Little Stanmore, St. Lawrence' s churchyard, frequent, 1965. **30:** East Barnet, St. Mary the Virgin's churchyard, occasional, 1968; Finchley, Hendon Lane, St. Mary's churchyard, frequent, 1968; Hendon, St. Mary Magdalene's churchyard, abundant, 1968; Totteridge, St. Andrew's churchyard, abundant, 1957-64. **31:** Tottenham, All Hallows' churchyard, abundant, 1968. **32:** Cockfosters, Christ Church churchyard, abundant on headstones, 1968; Edmonton, All Saints' churchyard, abundant, 1968; Southgate, Christ Church churchyard, on several headstones, 1968.

C. vitellina (Hoffm.)Müll.Arg.

Calcareous and acid stone. Nitrophilous. Local, chiefly on brick walls and the concrete sides of reservoirs.

6: Blackheath, Morden Road Mews, on brick wall, 1968, *Milne* (Herb. Milne). **7:** Lee Terrace, St. Margaret's churchyard, 1968, *Milne*. **13:** Banbury Reservoir and sides of River Lea, frequent, 1968; High Maynard Reservoir, locally abundant, 1964; Lockwood Reservoir, scarce, 1964; Warwick Reservoir (east), occasional, 1968. **19:** Beckenham, St. George's churchyard, on limestone memorial, 1968, *Wallace;* Beckenham, St. Paul's churchyard wall, 1968, *Wallace;* Elmstead Woods Station, frequent on brick wall, 1956-64. **20:** Shirley, on brick walls, 1967, *Wallace;* South Norwood Sewage Farm, scarce on concrete, 1963. **21:** Beddington, Church Lane, locally abundant on old brick wall, 1964-68; Beddington, St. Mary's churchyard, scarce, 1964; Beddington Sewage Farm, occasional on concrete channels and scarce on Irrigation Bridge, 1963. **22:** Morden, St. Lawrence's churchyard, occasional on gravestones and scarce on old brick wall to north, 1962. **24:** Barn Elms Reservoir, occasional, 1965; Ham, frequent on old brick walls, 1966. **31:** Banbury Reservoir, frequent, 1968. **32:** Banbury Reservoir, frequent, 1968; Cockfosters, Christ Church churchyard, on acid headstone, 1968.

[*C. xanthostigma* (Ach.) Lett. (*C. vitellina* var. *xanthostigma* (Ach.) Elenk.)

Bark. Nitrophilous.

13: Walthamstow, "in a wood, near Hale End", *Forster* (BM).]

[*Catillaria denigrata* (Fr.) Hedl. (*Biatorina synothea* Körb.; *Lecidea denigrata* (Fr.) Nyl.; *L. parassima* Nyl. ex Cromb.)

Wood.

7: Blackheath, on timber, Herb. *J. E. Smith* misc. lich. coll. (LINN). **30:** Golders Green, "on old pales", 1870, *Crombie* (BM); Hendon, Finchley Road, *Crombie* in Trimen & Dyer (1869, p. 406); "near Mill Hill", *Crombie* (BM).]

C. lenticularis (Ach.) Th. Fr.

Calcareous stone. Rare. New to the Area.

20: South Croydon, St. Peter's churchyard wall, 1968, *Wallace*. **24:** Barnes, St. Mary's churchyard, on chest-tomb, 1968; Kew, Royal Botanic Gardens, Herbarium Grounds, on asbestos-cement roof of spirit store, 1967, *Edwards* (BM, slide coll.). **32:** Edmonton, All Saints' churchyard, scarce, 1968, *Laundon* 2649 (BM, slide coll.).

[*C. lightfootii* (Sm.) Oliv. (*Lecidea lightfootii* (Sm.) Ach.)

Bark.

13: Walthamstow, *Forster* in Crombie (1885, p. 65).]

[*Chaenotheca aeruginosa* (Turn. ex Sm.) A. L. Sm. (*Calicium trichiale* auct. angl., non Ach.)

Wood.

30: Hendon, "old posts", *Crombie* in Trimen & Dyer (1869, p. 406).]

[*C. chrysocephala* (Ach.) Th. Fr. (*Calicium chrysocephalum* Ach.)

Wood.

13: Walthamstow, on timber, *Forster* (BM).]

C. ferruginea (Turn. ex Sm.) Migula (*Calicium melanophaeum* Ach.; *Chaenotheca melanophaea* (Ach.) Zwackh)

Bark and wood. Rare.

13: Walthamstow, "on pales in garden in Hoe Street", *Forster* (BM). **30:** "old pales, nr. Mill Hill", *Crombie* (BM); Mill Hill, in crevices on *Fraxinus* by Totteridge footpath near Folly Farm, 1957.

[*Cladonia arbuscula* (Wallr.) Rabenh. subsp. *arbuscula* (*C. rangiferina* auct. pro parte, non (L.) Weber; *C. sylvatica* auct.; *Lichen rangiferinus* auct. pro parte, non L.; *Lichenoides tubulosum ramosissimum fruticuli specie candicans, corniculis rufescentibus* Dill. in Ray (1724, p. 67) pro parte)

Heaths. On acid soil generally amongst *Calluna.*

6: Woolwich Heath, *Dillenius* in Herb. Synopsis (OXF) and Herb. Sherard (OXF). **22:** "Wimbledon Common, W.M.", herb. *G. Davies* (BM).]

C. bacillaris (Ach.) Nyl.

Acid humus soil. Scarce.

22: Mitcham Common, scarce on mor on bank on south side, 1964, *Laundon* 2472 (BM). **24:** Barnes Common, on humus in grass-heath, 1964, *Laundon* 2474 (BM); Ham Common, frequent, 1966; Richmond Park, "on slope just east of Lower [Pen] Pond Outlet", 1929, *Summerhayes* (K).

[*C. caespiticia* (Pers.) Flörke (*Cenomyce caespiticia* (Pers.) Ach.)

Acid humus soil.

31: "Hornsey Wood", *Forster* (BM).]

[*C. capitata* (Michaux) Spreng. (*Lichenoides fungiforme terrestre, capitulis fuscis* Dill. in Ray (1724, p. 70); *Lichen rufus* sensu Withering (1792, p. 171), non Huds.)

Bare acid soil with little or no humus development.

2: Hampstead Heath, *Dillenius* in Herb. Sherard (OXF).]

[*C. cervicornis* (Ach.) Flot. (*Lichenoides tubulosum pyxidatum exiguum, fusco-virens* Dill. in Ray (1724, p. 70) pro parte)

Bare acid soil.

6: Woolwich Heath, *Dillenius* in Herb. Synopsis (OXF).]

C. chlorophaea (Flörke ex Sommerf.)Spreng. (*C. pyxidata* var. *chlorophaea* (Flörke ex Sommerf.)Flörke; *Lichenoides tubulosum pyxidatum, marginibus serratis* Dill. in Ray (1724, p. 69))

Acid soil and acid and calcareous stone and formerly also on wood. Occasional.

6: Eltham Common, scarce on earth, 1960; Woolwich Heath, *Dillenius* (OXF, Herb. Synopsis). **7:** Sydenham, *Holmes* (1878, p. 211). **8:** Dulwich, frequent on disused tunnel wall at Crescent Wood Road, 1968. **10:** Putney Heath, frequent amongst *Calluna*, 1958-66. **12:** Brompton Cemetery, on moss on limestone and on marble chippings, 1956; Kensal Green Cemetery, scarce on moss on acid stone, 1958. **13:** "on decayed stumps near Chingford", *Crombie* (1885, p. 57). **17:** Manor Park Cemetery, scarce on lawns, 1961. **19:** Bromley, Church House Grounds, in rock garden, 1963. **21:** Beddington, Church Lane, scarce on old brick wall, 1968; Carshalton, The Grove, common in rock garden, 1965. **22:** Mitcham Common, occasional on sandy bank on south side, 1964; Wimbledon Common, "Common Brick arch at head of Farm Bog, ditch bank below Brickfield Cottage, wall on West Side, &c.", *Johnson* (1912, p. 277), burnt heathland, 1955. **24:** East Sheen Common, "south end, on brick wall", 1931, *Turrill* (K); Ham Common, scarce, 1966; Kew, Royal Botanic Gardens, *Darbishire* (1906, p. 102), "frequent on rocks in the Rock Garden . . . pathway near Tennis Courts", 1958, *Gilbert* in Shaw (1961, p. 190); Richmond Park, four records, 1929-34, *Ballard & Montford*, *Richmond*

Park Committee, *Summerhayes*, *Turrill*, near Sheen Common Gate, 1957, *Gilbert* (Herb. Gilbrt), abundant to south of East Sheen Gate, 1964. **25:** Isleworth, Park Road, on brick wall, 1958; Syon House Gardens, frequent on gravel paths, 1958-64 [absent, 1968]. **28:** Paddington Cemetery, scarce, 1958. **32:** Southgate, Christ Church churchyard wall, 1968.

Several literature records published as *Cladonia pyxidata* probably belong to *C. chlorophaea* and have therefore been included here.

C. coccifera (L.) Willd. (*C. cornucopioides* (L.) Fr. (1831), non Hoffm. (1796); *Muscus multiformiter pyxidatus apicibus coccineis* Petiver (1695, p. 12))

Heaths. On mor (= raw humus). Scarce.

10: Putney Heath, *Petiver* (*loc. cit.*), 1961. **22:** Wimbledon Common, frequent, 1956-61. **24:** Ham Common, scarce, 1966; Kew, Royal Botanic Gardens, *Darbishire* (1906, p. 102).

C. coniocraea (Flörke) Spreng.

Acid soil, acid and calcareous stone, tree-bases and stumps. Occasional.

2: Hampstead, amongst moss on wall, 1963, *R.W.M.Corner*. **6:** Blackheath, Morden Road Mews, on brick wall, 1968, *Milne* (Herb. Milne); Woolwich Common, locally frequent, 1956. **8:** Dulwich, scarce on disused tunnel wall at Crescent Wood Road, 1968. **10:** Putney Heath, scarce amongst *Calluna*, 1958. **12:** Brompton Cemetery, scarce on moss on limestone, 1956. **17:** Manor Park Cemetery, occasional on lawns, 1961. **21:** Beddington, Church Lane, scarce on old brick wall, 1968; Carshalton, The Grove, common in rock garden, 1965. **22:** Mitcham Common, scarce on sandy soil amongst *Ulex* on north side, 1953, on banks on south side, 1964, *Laundon* 2473 (BM); Wimbledon Common, scarce, 1956-66; Wimbledon Park Rubbish Tip, locally abundant on rubble, 1955, *Laundon* 1157 (BM). **23:** Coombe Hill, on wall, 1956. **24:** Barnes Common, scarce, 1958-64; East Sheen Common, "south end, on brick wall", 1931, (*K Turrill*); Ham, frequent on brick walls, 1966; Kew, Royal Botanic Gardens, a few plants in Rock Garden, 1968; Richmond Park, three records, 1929-31, *Milne-Redhead*, *Richmond Park Committee* (K), on earth to south of East Sheen Gate, 1964. **25:** Syon House Gardens, locally frequent on gravel paths, 1958 [absent, 1968]. **27:** Perivale Wood, at base of two *Quercus*, 1957. **31:** Coldfall Wood, on several stumps and on sandy soil, 1957; Queen's Wood, scarce at base of *Quercus*, 1958.

[*C. convoluta* (Lam.) P. Cout. (*C. foliacea* var. *endivifolia* (Dicks.) Schaer.; *Lichen foliaceus* auct. pro parte, non Huds.; *Lichenoides cartilaginosum, tubulis & pyxidulis exiguis* Dill. in Ray (1724, p. 70))

On bare soil with little or no humus development.

7: Blackheath, *Dillenius* in Herb. Sherard (OXF).]

C. crispata var. *cetrariiformis* (Del. ex Duby) Vain.

On mor amongst *Calluna*. Rare.

10: Putney Heath, scarce, 1958, *Laundon* 1860 (BM) (confirmed Ahti).

C. fimbriata (L.)Fr. (*C. ochrochlora* sensu A.L.Sm. pro parte, non Flörke; *Coralloides scyphis gracilibus tubiformibus, Pedicularis folio* Dill. (1741, p. 85); *Coralloides scyphis humilibus, intus fuscis* Dill. (op. cit. p. 86); *Lichen filiformis* Huds.; *Lichenoides tubulosum pyxidatum exiguum, fusco-virens* Dill. in Ray (1724, p. 70) pro parte)

Acid soil, acid and calcareous stone and decaying bark and wood. Occasional.

6: Blackheath, Morden Road Mews, on brick wall, 1968, *Milne* (Herb. Milne); Charlton, *Dillenius* (1741, p. 87); Woolwich Heath, *Dillenius* (OXF, Herb. Synopsis). **7:** Blackheath, *Dillenius* (1741, p. 86). **8:** Dulwich, abundant on disused tunnel wall at Crescent Wood Road, 1968. **12:** Brompton Cemetery, scarce, 1960; Kensal Green Cemetery, scarce, 1958; Kensington Gardens, on wall surrounding Italian Garden, 1969, *A. R. Vickery* (BM). **13:** "near Hale brinks", *Forster* (BM); "on decayed stumps in Little Hale brinks", *Forster* (BM); near Snaresbrook, *Forster* (BM); Upper Walthamstow, Epping Forest, scarce at base of *Betula*, 1956. **17:** Manor Park Cemetery, frequent on lawns, 1961; Wanstead Flats, occasional in S.E. corner, 1961. **19:** Bromley, Church House Grounds, in rock garden, 1963; Bromley, College Slip, scarce on old brick wall, 1962-66. **21:** Beddington, Church Lane, scarce on old brick wall, 1968; Carshalton, The Grove, common in rock garden, 1965. **22:** Beddington Sewage Farm, on Hundred Acre Bridge, 1964; Wimbledon Common, scarce on mor, 1964; Wimbledon Park Rubbish Tip, scarce on rubble, 1955, *Laundon* 1156 (BM). **24:** Barn Elms Reservoir, rare amongst moss, 1965; East Sheen Common, 1957, *Gilbert;* Kew, Burlington Avenue, on brick wall, 1968, *Gilbert* (Herb. Gilbert); Kew, Royal Botanic Gardens, many records, 1906-68; Richmond Park, "on stump near wall", 1932, *Summerhayes & Milne-Redhead* (K). **27:** Greenford, Holy Cross churchyard, at base of chest-tomb, 1967. **28:** Paddington Cemetery, scarce, 1958. **30:** East Barnet, St. Mary the Virgin's churchyard, scarce, 1968; Gt. Northern London Cemetery, scarce, 1960; Totteridge, St. Andrew's churchyard, occasional on limestone headstones, 1964. **32:** Edmonton Cemetery, scarce, 1960; Southgate, Christ Church churchyard wall, 1968.

C. floerkeana (Fr.) Flörke (*Lichenoides coralliforme, apicibus coccineis* Dill. in Ray (1724, p. 68))

Heaths. On mor. Scarce.

6: Woolwich Heath, *Dillenius* in Herb. Synopsis (OXF). **10:** Putney Heath, frequent amongst *Calluna*, 1958-66. **22:** Wimbledon Common, frequent, 1956-61. **24:** Ham Common, scarce, 1966; Richmond Park, near Sheen Common gate, 1957, *Gilbert* (Herb. Gilbert).

C. furcata (Huds.) Schrad. (*Lichen spinosus* Huds.; *Lichenoides tubulosum virescens, ramosius & foliosum, summitatibus arcuatis* Dill. in Ray (1724, p. 67))

Chiefly grass-heaths and moss-covered banks on acid soil where there is little or no development of mor. Local.

2: Hampstead, *Buddle* in Herb. Sloane **115:** 1 (BM). **6:** Woolwich Heath, *Dillenius* in Herb. Sherard (OXF). **10:** Putney Heath, scarce amongst *Calluna*, 1958. **13:** Walthamstow, "field near Hoe Street in Forest", *Forster* (BM); Upper Walthamstow, Epping Forest, on bank, 1956. **22:** Mitcham Common, on sandy soil amongst *Ulex* on north side, 1953; Wimbledon Park Rubbish Tip, scarce on rubble, 1955, *Laundon* 1155 (BM). **24:** Barnes Common, extensive patches in grass-heath in north part, 1958-64; Kew, Royal Botanic Gardens, "wood palings on the river-side path towards Richmond", *Darbishire* (1906, p. 102), "pathway near Tennis Courts", 1958, *Gilbert* in Shaw

(1961, p. 190), moss-covered bank in south part of Gardens, 1959; Richmond Park, Pond Plantation, near Eastern Boathouse of Upper Pen Pond, 1931, *Richmond Park Committee* (K), on ground near Sheen Common Gate, 1957, *Gilbert*. **25:** Syon House Gardens, occasional on gravel paths and amongst moss on lawns, 1958-64 [absent, 1968]. **31:** Hornsey, Herb. Sherard (OXF).

[*C. gracilis* (L.) Willd. (*Lichen scyphifer ramosus denticulatus filiformis* Hill (1759, p. 589))

Acid soil.

2: Hampstead, *Buddle* in Herb. Sloane **115:** 1 (BM); Hampstead Heath, 1696 or 1697, Herb. Sloane **285:** 32 (BM); Hampstead Heath, *Hill* (*loc. cit.*).]

C. impexa Harm.

Heaths. On acid soil amongst *Calluna*. Very rare.

2: Hampstead, *Buddle* in Herb. Sloane **115:** 1 (BM); Hampstead, Herb. Morison sheet 63.39 (OXF). **6:** Woolwich Heath, *Dillenius* in Herb. Sherard (OXF). **10:** Putney Heath, one plant, 1958.

C. macilenta Hoffm. (*C. digitata* var. *macilenta* (Hoffm.) Nyl.)

Acid humus soil, acid stone and decaying wood. Scarce.

10: Putney Heath, *Johnson* (1912, p. 277). **13:** Walthamstow, "on Salisbury Hall Pound, Chapel End", *Forster* (BM); "on rails of palings near Hoe street", *Forster* MSS. **19:** Elmstead Woods Station, frequent on moss on brick wall, 1956, scarce, 1964. **22:** Wimbledon Common, "ground under birches . . . Gravelly Hill, &c. Fairly abundant", Johnson (1912, p. 277), rare on stump, 1956.

[*C. pityrea* (Flörke) Fr. (*Coralloides parum ramosum, tuberculis fuscis* Dill. (1741, p. 97); *Lichen anomaeus* sensu Sm. pro parte, non *Baeomyces anomaeus* Ach.)

Acid soil.

6: Woolwich Heath, 1726, *Dillenius*, misc. coll. (OXF) and Herb. Sherard (OXF).]

C. pocillum (Ach.) O. J. Rich. (*C. pyxidata* var. *pocillum* (Ach.) Flot.)

Calcareous stone. Rare or extinct.

10: "on a wall at Putney turning into Wandsworth road", herb. *Rand* (BM).

C. pyxidata (L.) Hoffm. sensu stricto

Acid soil with little or no humus development, and acid and calcareous stone. Scarce.

2: Hampstead Heath, *J. E. Smith* (BM). **12:** Brompton Cemetery, scarce on moss on limestone, 1956, *Laundon* 1687 (BM). **13:** "heaths . . . near Chingford", *Crombie* (1885, p. 57). **24:** Kew, Royal Botanic Gardens, *Darbishire* (1906, p. 102); Richmond Park, near Sheen Common gate, 1957, *Gilbert* (Herb. Gilbert). **25:** Syon House Gardens, scarce on gravel paths, 1958-64 [absent, 1968].

[*C. rangiformis* Hoffm. (*C. pungens* (Ach.) Gray; *Lichenoides tubulosum ramosissimum fruticuli specie candicans, corniculis rufescentibus* Dill. in Ray (1724, p. 67) pro parte)

Bare soil with little or no humus development.

2: Hampstead, *Buddle* in Herb. Sloane **115:** 1 (BM). Hampstead, Herb. Morison sheet 633.10 (OXF). **6/7:** Blackheath or Woolwich, *Dillenius* in Herb. Sherard (OXF). **13:** Walthamstow, "on the Forest near Hagger Lane", *Forster* (BM).

The Dillenius and Forster specimens belong to the chemical strain devoid of fumarprotocetraric acid; the nature of the Buddle and Morison specimens did not permit this test.)

[*C. subulata* (L.) Weber (*C. cornutoradiata* (Coem.) Sandst.; *C. fimbriata* var. *radiata* (Schreb.) Fr.; *C. fimbriata* var. *subulata* (L.) Vain.)

Acid soil.

2: Hampstead, *Buddle* in Herb. Sloane **115:** 3 (BM).

Lichen subulatus is recorded in Forster MSS. from "near the Great bog between Salters buildings & the Windmill", Walthamstow; it may refer to this species.)

[*C. tenuis* (Flörke) Harm. (*Lichenoides tubulosum ramosissimum fruticuli specie candicans, corniculis rufescentibus* Dill. in Ray (1724, p. 67) pro parte)

Heaths. On acid soil amongst *Calluna.*

6: Woolwich Heath, *Dillenius* in Herb. Synopsis (OXF) and Herb. Sherard (OXF).

There are two specimens from Woolwich Heath in Herb. Synopsis, and crystal tests show that one belongs to the usnic acid chemical strain (var. *tenuis*) and the other to the strain devoid of this acid (var. *leucophaea* (des Abb.) Ahti).)

[*C. uncialis* (L.) Weber (*Coralloides perforatum minus, molle and tenue* Dill. (1741, p. 99); *Lichen uncialis* L.; *Lichenoides tubulosum, cauliculis mollioribus and crassioribus, majus* Hill (1759, p. 591); *Lichenoides tubulosum, cauliculis mollioribus and crassioribus, minus* Dill. in Ray (1724, p. 67))

Heaths. On acid soil generally amongst *Calluna.*

2: "On Hampstead Heath, 1748", *Hill* (*loc. cit.*). **6:** Woolwich Heath, *Dillenius* in Herb. Synopsis (OXF) and Herb. Sherard (OXF).]

[*C. verticillata* (Hoffm.) Schaer. (*Coralloides scyphiforme, marginibus radiatis and foliatis* Dill. (1741, p. 85))

Heaths.

2: Hampstead Heath, *Dillenius* (*loc. cit.*).]

Collema crispum (Huds.) Weber (*C. cheileum* (Ach.) Ach.)

Calcareous stone. Rare.

13: Walthamstow, "on sides of walls", *Forster* (BM). **29:** Little Stanmore, St. Lawrence's churchyard, scarce in crevices on top of chest-tomb, 1965.

The precise locality of the Walthamstow specimen is given in Forster MSS. as "Brickstile Walk, Woodstreet."

[*C. limosum* (Ach.) Ach. (?*C. glaucescens* Hoffm.; *Lichen limosus* Ach.)

Calcareous soil.

13: Walthamstow, "in a narrow lane near Hale brinks", *Forster* MSS. **20:** Croydon, *Holmes* in Malden (1902, p. 61). **24:** Kew, Royal Botanic Gardens, *Darbishire* (1906, p. 103).]

[*C. tuniforme* (Ach.) Ach. (*C. furvum* (Ach.) Ach.; *Lichen granulatus* sensu Forster, non Huds.)

Calcareous stone.

13: "on a tombstone in Walthamstow churchyard", *Forster* (BM). **30:** "in East Barnet churchyard", *Forster* (BM).]

[*Coniocybe furfuracea* (L.) Ach. (*Mucor furfuraceus* L.)

Acid soil and decaying bark.

13: "on an oak on the forest near Chingford hatch", *Forster* MSS.; Walthamstow, "on banks", *Forster* (BM).]

Cornicularia aculeata (Schreb.) Ach. sensu stricto (*Cetraria aculeata* (Schreb.) Fr.; *Lichenoides non tubulosum ramosissimum fruticuli specie, rufo-nigrescens* Hill (1759, p. 592))

Heaths. On acid soil generally amongst *Calluna.* Local.

2: Hampstead Heath, *Hill* (*loc. cit.*). **10:** Putney Heath, abundant in a few small areas, 1958-66. **22:** Wimbledon Common, 1937, *Avery* (Herb. C. P. Castell), locally frequent, 1956-66. **24:** Richmond Park, "on slope just west of Lower [Pen] Pond outlet, amongst open bracken", 1929, *Summerhayes*, near Sheen Common gate, 1957, *Gilbert* (Herb. Gilbert).

[*Cyphelium inquinans* (Sm.) Trevis. (*Lichen inquinans* Sm.; *Trachylia tympanella* (Ach.) Fr.)

Wood.

13: Walthamstow, "old post and rails", *Forster* (BM). **30:** Totteridge, "old posts", *Crombie* (BM).]

[*C. tigillare* (Ach.) Ach. (*Lichen tigillaris* Ach.; *Trachylia tigillaris* (Ach.) Fr.)

Wood.

13: Walthamstow, "paling near Hoe Street (now destroyed)", *Forster* (BM); "On a barn between Wood Street, Walthamstow, and the Forest", *Forster* (BM).]

[*Dermatocarpon hepaticum* (Ach.) Th. Fr. (*Endocarpon hedwigii* auct., non *Lichen hedwigii* Ach. nom. illeg.; *Endocarpon hepaticum* Ach.; *Lichen trapeziformis* auct., non König)

Soil.

13: Walthamstow, "on ant hills in Epping Forest near the Great Bog near Salters buildings", *Forster* (BM). **20:** "supra terram, in ericetis sterilibus, prope Croydon", *Dickson* (1790, p. 23).]

[*Diploschistes scruposus* (Schreb.) Norm. (*Urceolaria scruposa* (Schreb.) Ach.)

Acid stone and soil.

13: Walthamstow, "Garden, Hoe Street", on wall and ground, *Forster* (BM). **24:** "Grass walls of Kew Gardens, August 1798, *R. Brown*" (BM).]

[*Evernia prunastri* (L.) Ach.

Bark.

13: Walthamstow, on "trees", *Forster* (BM).]

[*Graphis scripta* (L.) Ach.

Smooth shaded bark.

13: Walthamstow, "near Salter's Buildings, and between Walthamstow and Loughton", *Forster* in Crombie (1885, p. 68). **14:** "between Woodford Wells and Chingford Hatch", *Forster* (BM, with *Phaeographis dendritica*).]

[*Lecania cyrtella* (Ach.) Th. Fr. (*Biatorina cyrtella* (Ach.) Th. Fr.; *Lichen cyrtellus* (Ach.) Sm.)

Bark.

13: Walthamstow, *Forster* MSS.]

L. erysibe (Ach.) Mudd

Acid and calcareous stone, chiefly the latter. The form *erysibe* is local, whereas the form *sorediata* Laundon is common and usually sterile; intermediate forms are also occasionally found. For further information see Laundon (1967, p. 315).

Inner record (forma *sorediata*): **2:** St. Pancras, Heathcote Street, St. George's Gardens, abundant on two chest-tombs, 1967. The forma *erysibe* is recorded from **6, 11, 12, 17, 20-22, 24, 25, 27, 28, 30, 32.** The forma *sorediata* is recorded from **1, 2, 6, 7, 9, 11, 13, 14, 16, 17, 19, 22, 24, 25, 27-32.**

Lecanora atra (Huds.) Ach. (*Muscus crustaceous Leprosus scutis nigricantibus* Petiver (1695, p. 12))

Brick walls. Nitrophilous. Rare.

21: Beddington, Church Lane, several plants on old brick wall, 1961-68. **London:** "some walls about London", *Petiver* (*loc. cit.*).

By 1968 the Beddington plants were in poor condition and had lost their apothecia which were present in 1961.

L. calcarea (L.) Sommerf. sensu stricto

Confined to the tops of old limestone chest-tombs and horizontal gravestones in churchyards. Scarce.

10: Tooting, St. Nicholas's churchyard, several plants, 1968. **13:** Leyton, St. Mary the Virgin, abundant on a limestone slab, 1969. **14:** Wanstead, St. Mary's churchyard, scarce, 1963; Woodford, St. Mary the Virgin's churchyard, abundant on three tombs, 1967. **19:** Beckenham, St. George's churchyard, on chest-tomb, 1968. **21:** Beddington, St. Mary's churchyard, abundant on two tombs, 1961-67. **22:** Morden, St. Lawrence's churchyard, scarce, 1961-65; Wimbledon, St. Mary's churchyard, abundant, 1956-64. **24:** Petersham, St. Peter's churchyard, occasional, 1968. **27:** Greenford, Holy Cross churchyard, a few plants, 1967; Hanwell, St. Mary's churchyard, on one memorial, 1967; Perivale churchyard, on one stone, 1966. **29:** Little Stanmore, St. Lawrence's churchyard, scarce, 1965. **30:** East Barnet, St. Mary the Virgin's churchyard, on slab, 1968; Hendon, St. Mary Magdalene's churchyard, scarce on slab, 1968; Totteridge, St. Andrew's churchyard, several plants, 1964.

L. campestris (Schaer.) Hue (*L. subfusca* auct. pro parte, non (L.) Ach.; *Lichenoides crustaceum & leprosum, scutellis subfuscis* Dill. in Ray (1724, p. 71))

Calcareous stone. Scarce.

7: Blackheath, *Dillenius* (*loc. cit.*). **19:** Beckenham, St. Paul's churchyard wall, one plant, 1968, *Wallace.* **22:** Beddington Sewage Farm, scarce on concrete channels in Hundred Acre Lane, 1962-63; Morden, St. Lawrence's churchyard, scarce, 1961. **27:** Greenford, Holy Cross churchyard, one plant, 1967; Hanwell, St. Mary's churchyard, two plants, 1967. **29:** Little Stanmore, St. Lawrence's churchyard, scarce on top of chest-tomb, 1965. **30:** Totteridge, St. Andrew's churchyard, four large plants on chest-tombs, 1957-64. **North London:** "walls in the suburbs", *Crombie* in Trimen & Dyer (1869, p. 406).

[*L. carpinea* (L.) Vain.

Bark.

13: Walthamstow, *Forster* (BM, with *Buellia canescens*).]

[*L. chlarona* (Ach.) Nyl.

Bark.

13: Walthamstow, "on the Forest near Salters buildings", *Forster* (BM).]

[*L. chlarotera* Nyl. (*L. allophana* auct. angl. pro parte, non (Ach.) Nyl.; *Lichen crustaceus albicans, scutellis subfuscis: margine cinereo subcrenato* Hill (1759, p. 581); *Lichen subfuscus* auct. pro parte)

Bark and wood.

11: Fulham, "On old Pales", *Hill* (*op. cit.* p. 582), "Thames at Bishop's Walk", *Cooper* (1836, p. 113). **13:** Walthamstow, *Forster* (BM).]

L. conizaeoides Nyl. ex Cromb. (*L. conizaea* auct. angl., non (Ach.) Nyl.; *L. pityrea* Erichs.; *L. varia* auct. pro parte, non (Hoffm.) Ach.)

Bark, wood, acid stone and roofing felt; rarely calcareous stone. Rare in the inner area but frequent or abundant in the Suburban Ring and beyond.

Inner records: **1:** Buckingham Palace Garden, scarce on trees, 1960, *J. Murray*, on sandstone bridge, *Buck* (1964, p. 37); Hyde Park, scarce at base of *Populus* and *Ulmus*, 1964-67. Also recorded from **2, 4-14, 16, 17, 19-25, 27-32.**

L. contorta (Hoffm.) Steiner (*Lichen hoffmannii* Ach., nom. illegit.)

Confined to the tops of old limestone chest-tombs in churchyards. Scarce. New to the Area.

9: Streatham, St. Leonard's churchyard, on tomb, 1968. **10:** Tooting, St. Nicholas's churchyard, abundant on tomb, 1968. **14:** Woodford, St. Mary the Virgin's churchyard, on one tomb, 1967. **27:** Greenford, Holy Cross churchyard, on two tombs, 1967. **30:** East Barnet, St. Mary the Virgin's churchyard, on one slab, 1968.

L. dispersa (Pers.) Sommerf. (*L. crenulata* sensu Darb. (1906, p. 102), non (Dicks.) Hook,; *L. galactina* Ach.; *L. hagenii* auct. angl., non (Ach.) Ach.; *L. urbana* Nyl.)

Calcareous stone and wood. The most common lichen. Abundant throughout the suburbs but in Central London confined to open spaces, *e.g.*, formerly abundant on the open bombed sites in the **CITY,** but absent from high density Mayfair and Soho. Forms a zone on calcareous substrata above high-water mark (above a zone of green algae) along the River Thames throughout the Area. Occurs at high-water mark on wooden piles in the Thames at **10:** Battersea Church Wharf, 1956, *Laundon* 1723 (BM). At **23:** Hogsmill Valley Sewage Works, it is abundant on wooden railway sleepers. All the inner records are represented by forma *dissipata* (Nyl.) B. de Lesd., which frequently forms conspicuous black patches on white limestone walls. The forma *albescens* (Hoffm.) Laundon is occasionally present in the Suburban Ring. Recorded from **CITY, 1-14, 16, 17, 19-25, 27-32.**

[*L. expallens* Ach.

Wood.

30: Mill Hill, "on pales", *Crombie* (BM, with *Lecidea symmicta* var. *symmictera*).]

L. muralis (Schreb.) Rabenh. (*Lichen muralis* Schreb.; *Squamaria muralis* (Schreb.) Elenk.)

Acid and calcareous stone and wood, chiefly in habitats with low evaporation rates. Nitrophilous. Well distributed, and common on asbestos-cement sheeting in the Suburban Ring.

Inner records: **1:** Belgravia, Little Chester Street, on asbestos-cement roof, 1968, *Wallace;* **2:** St. Pancras, Wren Street, St. Andrew's Gardens, one plant on chest-tomb, 1967. Also recorded from **4-6, 11-14, 17, 19-22, 24, 25, 27-32.**

[*L. pallida* (Schreb.) Rabenh. (*Lichen albellus* Pers.)

Smooth bark.

13: Walthamstow, "wood near Hale End", *Forster* MSS.]

[*L. piniperda* Körb.

Wood.

29/30: "On old pales. Near Edgware", 1872, *Crombie* (BM). **30:** Mill Hill, *Crombie* (BM).]

L. polytropa (Hoffm.) Rabenh.

Acid stone. Rare. New to the Area.

19: Penge, Anerley Hill, covering a sandstone pier coping at St.

Katharines, 1968. **27:** Greenford, Holy Cross churchyard, two plants on acid headstone, 1967.

[*L. varia* (Hoffm.) Ach.

Wood.

7: Blackheath, 1806, Herb. *J. E. Smith* sheet 1693.12 and misc. lich. coll. (LINN). **13:** Walthamstow, "on rails", *Forster* (BM). **30:** Finchley, "on pales", *Crombie* (BM).]

Lecidea coarctata (Sm.) Nyl. (*Lichen coarctatus* Sm.)

Acid and (rarely) calcareous stone, usually brick walls. Scarce.

2: Hampstead, garden wall, 1960, *Brightman;* Waterlow Park, on brick wall, 1958. **4:** Finsbury Park Road, on brick wall dividing No. 74-76, 1958-60. **6:** Blackheath, Lee Road, Manor Way and Morden Road, on brick walls, 1968, *Milne* (Herb. Milne). **7:** Blackheath, Camden Row, on wall, 1968, *Milne.* **13:** Walthamstow, "on bricks . . . near Salter's Buildings", *Forster* in Crombie (1885, p. 65). **19:** Beckenham, Brackley Road, 1968, *Wallace*; Bromley, Church House Grounds, rock garden, 1963. **20:** Shirley, Cheston Avenue, on crumbling brick wall, 1967, *Wallace;* Shirley, West Way, 1969, *Wallace.* **22:** Mitcham Watermeads, on brick weir, 1967; Morden old wall to north of St. Lawrence's church, 1962. **24:** Kew, Royal Botanic Gardens, on brickwork of wall, 1960, *Gilbert* (Herb. Gilbert), several plants in the Rock Garden, 1968; Petersham, St. Peter's churchyard wall, a few plants, 1968; Richmond, brick wall in riverside gardens, 1962; Richmond Park, on brick, 1956, *Gilbert.* **30:** Hendon, "brick walls", *Crombie* (BM). **32:** Southgate, Christ Church churchyard wall, on brick and mortar of coping, 1968.

L. fuscoatra (L.) Ach. (*Lichen contiguus* Sm., ?pro parte, non *Verrucaria contigua* Hoffm.)

Acid stone. Rare.

9: Kennington, on brick walls, *Smith & Sowerby* (1801, *tab.* 821). **13:** Walthamstow, *Forster* MSS. **21:** Beddington, Church Lane, scarce on brick of old wall, 1968.

L. granulosa (Hoffm.) Ach. (*L. flexuosa* (Fr.) Nyl. (1856), non Fr. (1825))

Mor (=raw humus) and decaying bark and wood. Scarce.

10: Putney Heath, scarce amongst *Calluna*, 1958-61. **19:** Bromley, Logs Hill, common on decayed fence, 1957. **22:** Wimbledon Common, occasional on mor, 1956. **24:** Barnes Common, scarce on soil, 1958; Richmond Park, Pond Plantation, on fallen branch near Eastern Boathouse of Upper Pen Pond, 1931, *Richmond Park Committee* (K). **29:** Little Stanmore, St. Lawrence's churchyard, on timber, 1965. **30:** Finchley, "old pales", *Crombie* (BM); near Mill Hill, "on old pales", 1870, *Crombie* (BM). **31:** Queen's Wood, scarce on stump, 1958.

[*L. limitata* (Scop.) Gray (*L. elaeochroma* (Ach.) Ach.; *L. olivacea* Massal.; *L. parasema* (Ach.) Ach. pro parte)

Bark.

13: Walthamstow, *Forster* (BM, with *Buellia canescens*).]

L. lucida (Ach.) Ach.

Brick walls and acid gravestones. Scarce.

6: Blackheath, Morden Road Mews, on crumbling mortar on shaded brick wall, 1968, *Milne* (Herb. Milne). **19:** Bromley, Church Road, on wall, 1963; Bromley, College Slip, on mortar of old brick wall, 1962-66. **21:** Beddington, Church Lane, scarce on old brick wall, 1958 [absent, 1964]. **25:** Syon Park, scarce on brick wall, 1958. **30:** East Barnet, St. Mary the Virgin's churchyard, on vertical surface of headstone, 1968; Totteridge, St. Andrew's churchyard, scarce on shaded gravestone, 1957.

[*L. scalaris* (Ach.) Ach. (*L. ostreata* (Hoffm.) Schaer.; *Lichen scalaris* Ach.; *Psora ostreata* Hoffm.)

Decorticated wood on timber and stumps.

2: Hampstead, *Crombie* (BM). **13:** Walthamstow, "in garden in Hoe Street", Forster (BM). **30:** Finchley, *Crombie* in Trimen & Dyer (1869, p. 406); Hendon, *Crombie* (BM); Totteridge, "on old palings", 1870, *Crombie* (BM).]

L. stigmatea Ach. (*L. goniophila* auct. angl. pro parte, non Flörke)

Calcareous stone, chiefly in habitats with low evaporation rates. Common on asbestos-cement roofs, but scarce elsewhere.

1: Regent's Park, The Holme, on limestone above dried-out pond, 1967. **13:** Walthamstow, sides of River Lea, occasional, 1968. **14:** Clayhall, Rushden Gardens, on asbestos-cement roof of shed, 1966, *I. Tittley* (BM); Woodford, St Mary the Virgin's churchyard, on chest-tomb, 1967. **19:** Beckenham, St. Paul's churchyard wall, 1968, *Wallace*. **20:** South Croydon, St. Peter's churchyard wall, 1968, *Wallace*. **22:** Beddington Sewage Farm, occasional on concrete channels in Hundred Acre Lane, 1963-64; Merton, Erridge Road, abundant on asbestos-cement roof, 1968. **24:** Kew, Royal Botanic Gardens, Herbarium Grounds, on asbestos-cement roof of spirit store, 1967, *Edwards* (Herb. Edwards); Petersham, St. Peter's churchyard, on headstone, 1968. **27:** Perivale, Horsenden Lane, Brown & Polson's factory, common on asbestos-cement roof of restaurant, 1968, *Edwards* (Herb. Edwards). **32:** Edmonton, sides of River Lea, occasional, 1968.

L. sulphurea (Hoffm.) Wahlenb. (*Lecanora sulphurea* (Hoffm.) Ach.)

Brick walls. Rare.

13: Walthamstow, "on the wall of Shernhall garden", *Forster* (BM). **21:** Beddington, Church Lane, locally abundant on old brick wall, 1961-68.

By 1968 the Beddington plants had declined in number and were in poor condition although still fertile.

[*L. symmicta* var. *symmictera* (Nyl.) Hedl. (*Lecanora symmictera* Nyl.)

Wood.

30: Mill Hill, on timber, *Crombie* (BM).]

L. uliginosa (Schrad.) Ach. (*Biatora uliginosa* (Schrad.) Fr.; *Lecidea fuliginea* Ach.; *L. humosa* (Hoffm.) Leight.)

Acid humus soil and decaying wood. Scarce.

2: Hampstead Heath, abundant, *Crombie* in Trimen & Dyer (1869, p. 406). **6:** Woolwich, Castle Wood, on decorticated stump, 1960. **10:** Putney Heath, amongst *Calluna*, 1961. **22:** Mitcham Common, on banks and amongst *Calluna* on south side, 1964; Wimbledon Common, rare, 1956-61. **24:** Barnes Common, several plants on soil, 1958-64; Ham Common, frequent, 1966; Richmond Park, on rotting *Quercus*, 1947, *Commonwealth Mycological Institute* (IMI). **30:** Finchley, "on old pales", 1873, *Crombie* (BM); Mill Hill, "on old posts", *Crombie* (BM).

[*Lepraria candelaris* (L.) Fr. (*Crocynia flava* (Schreb.) Hue nom. illeg.; *Lepraria flava* (Schreb.) Sm. nom. illeg.)

Shaded bark and wood.

7: Blackheath, on timber, Herb. *J. E. Smith* misc. lich. coll. (LINN). **13:** Walthamstow, *Forster* MSS.]

L. incana (L.) Fr. (*Lepraria aeruginosa* auct., non (Weiss) Sm.)
Shaded bark and shaded stone, rarely on shaded acid soil with little or no humus development. Occasional, chiefly in the Suburban Ring and beyond.

1: Regent's Park, The Holme, frequent on shaded mortar, clinker and plant roots, 1967. **6:** Blackheath, Morden Road Mews, on brick wall, 1968, *Milne* (Herb. Milne); Oxleas Wood, scarce on bark, 1960. **7:** Lee Terrace, St Margaret's churchyard, 1968, *Milne.* **8:** Dulwich, frequent on disused tunnel wall at Crescent Wood Road, 1968. **12:** Brompton Cemetery, rare on gravestone, 1956. **13:** Leyton, St. Mary the Virgin's churchyard, on chest-tomb, 1969; Upper Walthamstow, Epping Forest, scarce on *Carpinus,* 1960; Walthamstow, *Forster* MSS. **19:** Beckenham, St. George's churchyard, on bark, 1968, *Wallace;* Beckenham, St. Paul's churchyard, on wood and stone, 1968, *Wallace;* Bromley, Church Road and Church House Grounds, on walls, 1963; Bromley, College Slip, frequent on walls, 1966; Bromley, Logs Hill, frequent on sandy banks, 1964;Bromley, Mavelstone Road, frequent on acid wall, 1957-64; Elmstead Wood, rare at base of tree, 1956. **21:** Beddington, Church Lane, several plants, 1964-68; Beddington, St. Mary's churchyard, scarce, 1964; Beddington Sewage Farm, on Irrigation Bridge, 1962-63; Carshalton, The Grove, common on stones in rock garden, 1965. **22:** Merton, Church Path, on brick wall, 1964; Mitcham, Tramway Path, at base of *Ulmus,* 1961; Morden, Central Road, on *Ulmus,* 1965; Morden Park, on *Ulmus,* 1962; Morden, St. Lawrence's churchyard, scarce, 1965; Ravensbury Park, on brick wall and on *Platanus,* 1961-66; Wimbledon Common, scarce, 1956-66; Wimbledon, Marryatt Road, on vertical shaded stone in garden, 1954, *Laundon* 856 (BM); Wimbledon, St. Mary's churchyard, scarce, 1962. **23:** Coombe Hill, on moss on wall, 1956; Norbiton, Lower Marsh Lane, on bole, 1966. **24:** Kew, Royal Botanic Gardens, "on concrete of pavilion by Tennis Courts . . . frequent on wall near tow-path, and abundant on wall near Director's Office", *Shaw* (1961, p. 190); Petersham, St. Peter's churchyard wall, a few plants, 1968; Richmond, Petersham Road, on wall, 1966. **30:** East Barnet, St. Mary the Virgin's churchyard, on three chest-tombs, 1968; Gt. Northern London Cemetery, frequent on one *Ulmus,* 1960; Mill Hill, frequent on roadside *Ulmus* trees, and on *Fraxinus* by Totteridge footpath, 1957; Totteridge, on brick and concrete, 1957; Totteridge, St. Andrew's churchyard, scarce, 1957-64. **31:** Alexandra Park Road, scarce on wall, 1968; Coldfall Wood, scarce on *Quercus* and old stump, 1957; Queen's Wood, scarce on *Quercus,* 1958.

[*L. membranacea* (Dicks.) Vain. (*Crocynia lanuginosa* Hue; *Leproloma lanuginosum* Nyl.)
Shaded stone.

24: Kew, Royal Botanic Gardens, *Darbishire* (1906, p. 103).]

[*Leptogium lichenoides* (L.) Zahlbr. (*L. pulvinatum* (Hoffm.) Nyl.)
Calcareous soil.

13: Walthamstow, Hale End, "on the Forest near the Windmill (now Mill Cottage)", *Forster* (BM).]

[*L. palmatum* (Huds.) Mont. (*Lichen palmatus* Huds.; *Lichenoides gelatinosum tenerius laciniatum, ex fusco purpurascens* Dill. in Ray (1724, p. 72))
Soil.
2: Hampstead Heath, *Dillenius* in Herb. Sherard (OXF). **13:** Walthamstow, "on the Forest near Hale End", Forster (BM).]

[*L. tenuissimum* (Dicks.) Körb. (*L. subtile* (Schrad.) Torss.; *Lichen subtilis* Schrad.)
Calcareous soil.
13: Walthamstow, "on the Forest near Hale End at the edge of a Clay-pit", *Forster* (BM); "near Hale End, Walthamstow . . . 1791", *Forster* in Herb. J. E. Smith sheet 1701.12 (LINN).]

Ochrolechia androgyna (Hoffm.) Arnold
Bark. Rare.
22: Wimbledon Common, one plant on *Betula pubescens* in Farm Ravine, 1956.

[*O. parella* (L.) Massal.
Brick walls.
6: "Greenwich Park wall", *Forster* (BM).]

[*Opegrapha atra* Pers.
Bark.
13: "on a tree in the Forest near Chingford Hatch" [on *Carpinus*], *Forster* (BM, with *Opegrapha varia*); Walthamstow, Hoe Street and between Hale End and Chapel End, *Forster* in Crombie (1885, p. 68).]

[*O. herbarum* Mont. (*O. betulina* Sm. (1811), non Pers. (1794))
Bark.
13: Walthamstow, "on the Forest near Salters buildings", *Forster* (BM).]

[*O. varia* Pers. (*O. diaphora* (Ach.) Ach. nom. illeg.; *O. lichenoides* Pers.; *O. rimalis* Ach.)
Bark.
13: "on a tree in the Forest near Chingford Hatch" [on *Carpinus*], *Forster* (BM). **30:** "old trees near Mill Hill" [on *Ulmus*], *Crombie* (BM).]

[*O. vulgata* (Ach.) Ach. sensu lato
Bark.
13: Walthamstow, "in the garden, Hoe Street", *Forster* in Crombie (1885, p. 68).]

[*Pannaria pezizoides* (Weber) Trevis.
Soil.
24: Kew, Royal Botanic Gardens, "on bare ground; formerly common on slope of bank facing Palace Grounds", *Darbishire* (1906, p. 103).]

[*Parmelia caperata* (L.) Ach.
Wood.
13: Walthamstow, "on rails of paling in garden in Hoe Street", *Forster* (BM).]

[*P. glabratula* (Lamy) Nyl. subsp. *glabratula* (*Lichen olivaceus* sensu Hudson (1762, p. 446) pro parte, non L.; *Lichenoides olivaceum, scutellis amplioribus verrucosis* Dill. (1741, p. 184) pro parte)
Bark.
6: Woolwich, "Shooter's Hill", *Dillenius* (*loc. cit.*).]

P. physodes (L.) Ach. (*Hypogymnia physodes* (L.) Nyl.)
Bark and wood. Rare or extinct.
13: Walthamstow, "garden in Hoe Street", *Forster* (BM). **24:** Richmond

Park, "S.E. of Bog Lodge", 1929, *Summerhayes* (K). **30:** Mill Hill, one plant on bark at base of old *Ulmus* stump by roadside, 1957.

[*P. saxatilis* (L.) Ach.

Bark and possibly acid stone.

22: Wimbledon Common, "on trunk of birch", *Johnson* (1912, p. 277). **24:** Kew, Royal Botanic Gardens, *Darbishire* (1906, p. 102).]

[*P. subaurifera* Nyl.

Bark.

6: Charlton Wood, *Dillenius* in Herb. Sherard (OXF). **10:** near Tooting, *Crombie* (1894, p. 252).]

[*P. subrudecta* Nyl. (*P. borreri* auct. pro parte, non (Sm.) Turn.; *P dubia* (Wulf.) Schaer. (1840), non (Hoffm.) Flörke (1819))

Bark.

13: Walthamstow, "on apple trees in Hoe Street", *Forster* (BM).]

P. sulcata Tayl.

Concrete; formerly also on stumps. Rare.

24: Richmond Park, near Barnes Cemetery, "between Rifle Range and Poplar Pond, on stump in grassland", 1930, *Ballard & Montford* (K). **31:** Wood Green, Vallance Road, one plant on concrete coping of front garden wall of No. 14, 1968, *E. T. Rose*, *Laundon*.

[*P. tubulosa* (Schaer.) Bitt.

Wood.

30: Mill Hill, "on larch pales", *Crombie* (BM).]

[*Peltigera canina* (L.) Willd.

Soil. Amongst grasses.

1: "this grows by Roadsides, and on Banks in dry Places—as in Hyde Park", 18th century, *Hill* (BM). **24:** Kew, Royal Botanic Gardens, *Darbishire* (1906, p. 103).]

[*P. polydactyla* (Neck.) Hoffm.

Soil.

2: Hampstead, *Crombie* in Trimen & Dyer (1869, p. 406). **6:** Woolwich Heath, *Dillenius* in Herb. Sherard (OXF).]

[*P. rufescens* (Weiss) Humb.

Soil.

6: Woolwich Heath, *Dillenius* in Herb. Sherard (OXF).]

[*Pertusaria albescens* (Huds.) Choisy & Wern. var. *albescens* (*Lichen discoideus* (Pers.) Sm.; *Pertusaria discoidea* (Pers.) Malme; *P. globulifera* (Turn.) Massal.)

Bark. Nitrophilous.

9: Lambeth, on *Fagus*, herb. *Sowerby* (BM). **13:** Walthamstow, *Forster* MSS. **32:** Southgate, on *Quercus*, *Dillenius*, misc. coll. (OXF).]

[*P. amara* (Ach.) Nyl. (*Musco-fungus tartaricus albescens rugosus farinaceus* Morison (1699, p. 634); *Variolaria faginea* auct. pro parte, ?non (L.) Pers.)

Bark.

2: Hampstead, "on Trees in Cainwood" [Kenwood], Herb. Morison sheet 634.11 (OXF). **13:** Walthamstow, *Forster* MSS.]

[*P. flavida* (DC.) Laundon (*Lepraria lutescens* (Hoffm.) Ach.; *Pertusaria lutescens* (Hoffm.) Lamy (1878), non (Eschw.) Krempelh. (1874))

Bark.

13: Walthamstow: "on a tree in the woody part of Epping Forest near Hagger Lane", *Forster* (BM).]

[*Phaeographis dendritica* (Ach.) Müll. Arg. (*Graphis dendritica* (Ach.) Ach.)
Smooth bark.
14: "between Woodford Wells & Chingford Hatch", *Forster* (BM).]

Physcia adscendens (Th. Fr.) Oliv. emend. Bitt. (*P. tenella* sensu Brightman (1959), non (Scop.) DC.)
Acid and calcareous stone; formerly also on bark. Nitrophilous. Scarce. For distribution map see Fig. 2E.
13: Walthamstow, "on trees", *Forster* (BM). **19:** Crystal Palace, North Tower Gardens, on asbestos-cement roof [now demolished], 1958, *Brightman* (*loc. cit.*); Elmstead Woods Station, frequent on brick wall, 1956, one plant only, 1964. **20:** Shirley, Wickham Road, on tiled roof, 1969, *Wallace*; South Croydon, St. Peter's churchyard, 1968, *Wallace*. **21:** Beddington, Church Lane, scarce on old brick wall, 1968; Beddington, St. Mary's churchyard, frequent, 1961-64; Sutton, Benhilton, All Saints' churchyard, scarce, 1965. **29:** Little Stanmore, St. Lawrence's churchyard, scarce, 1965. **30:** Totteridge, St. Andrew's churchyard, occasional, 1964.

[*P. aipolia* (Ehrh. ex Humb.) Hampe (*P. stellaris* var. *cercidia* (Ach.) Th. Fr.)
Bark. Nitrophilous.
13: Walthamstow, "on dead branches of a willow tree in the Garden", *Forster* (BM). **29/30:** near Edgware, *Crombie* (BM).]

P. caesia (Hoffm.) Hampe (*Lichen caesius* Hoffm.)
Calcareous stone. Nitrophilous. Locally frequent in the Suburban Ring and beyond, chiefly on churchyard memorials.
7: Lee Terrace, St. Margaret's churchyard, abundant on chest-tomb dated 1847, 1968, *Milne* (Herb. Milne); Lewisham High Street, St. Mary's churchyard, a few plants on headstone, 1968. **11:** Fulham, All Saints' churchyard, abundant on two chest-tombs, and scarce on a third, 1968. **13:** Banbury Reservoir, scattered plants on east side, 1968; Walthamstow, "on tiles", *Forster* (BM). **14:** Wanstead, St. Mary's churchyard, frequent, 1956-63; Woodford, St. Mary the Virgin's churchyard, abundant on several headstones, 1967. **19:** Beckenham, St. George's churchyard, frequent, 1968; Beckenham, St. Paul's churchyard wall, 1968, *Wallace*. **20:** Shirley, Bennets Way, Devonshire Way, Langland Gardens, Orchard Avenue, West Way and Wickham Road, 1967-69, *Wallace*. **21:** Beddington, St. Mary's churchyard, frequent, 1961-64; Beddington Sewage Farm, abundant on concrete channels, 1962-69, *Laundon* 2475 (BM); Sutton, Benhilton, All Saints' churchyard, frequent, 1965. **22:** Beddington Sewage Farm, locally abundant, 1962-64; Merton, St. Mary's churchyard, scarce, 1961-64; Morden Hall Park, on plinth, 1961-64; Morden, St. Lawrence's churchyard, frequent, 1961-65; Wimbledon, St. Mary's churchyard, occasional, 1962. **24:** Kew, Royal Botanic Gardens, Herbarium Grounds, a few plants on asbestos-cement roof of spirit store, 1967, *Edwards* (Herb. Edwards); Petersham, St. Peter's churchyard, on coped stone, 1968; Richmond House, herb. *Sowerby* (BM). **25:** Syon House Gardens, on edge of small pond, 1964 [absent, 1968]. **27:** Greenford, Holy Cross churchyard, several plants on two memorials, 1967; Perivale, Horsenden Lane, Brown & Polson factory, uncommon on asbestos-cement roof of restaurant, 1968, *Edwards* (Herb. Edwards). **29:** Little Stanmore, St. Lawrence's churchyard, frequent, 1965. **30:** East Barnet, St.

Mary the Virgin's churchyard, abundant on headstones, 1968; Gt. Northern London Cemetery, scarce, 1960; St. Marylebone Cemetery, abundant on headstones, 1960; St. Pancras and Islington Cemetery, frequent, 1957; Totteridge, St. Andrew's churchyard, abundant, 1957-64. **32:** Cockfosters, Christ Church churchyard, abundant on headstones, 1968; Edmonton, All Saints' churchyard, abundant on several headstones, 1968.

[*P. clementei* (Sm.) Maas Geest. (*Lichen clementei* Sm.)

Bark.

21: "hedges by Carshalton", *Borrer* MS. in Turner & Dillwyn (1805, facing p. 595) (BM copy).]

[*P. leptalea* (Ach.) DC.

Bark. Nitrophilous.

13: Walthamstow, "on trees", *Forster* (BM, with *Physcia adscendens*).]

P. nigricans (Flörke) Stiz.

Calcareous stone. Nitrophilous. Rare.

19: Beckenham, St. George's churchyard, on limestone memorial, 1968, *Laundon* 2648 (BM). **21:** Beddington Sewage Farm, Mile Road, scarce on concrete channel amongst *P. orbicularis*, 1964, *Laundon* 2476 (BM).

P. orbicularis (Neck.) Poetsch (*Lichen virellus* Ach.; *Physcia virella* (Ach.) Flag.)

Calcareous stone; formerly also on bark. Nitrophilous. Occasional, chiefly in the Suburban Ring, usually on walls or churchyard memorials. For distribution map see Fig. 2c.

6: Eltham Palace, on limestone wall of bridge, 1968, *J. P. Showell.* **7:** Lewisham High Street, St. Mary's churchyard, abundant on two headstones to west of tower, 1968. **13:** "on the Forest near Hale End" [on bark], *Forster* (BM). **14:** Wanstead, St. Mary's churchyard, frequent, 1956. **19:** Beckenham, St. George's churchyard, a few plants on headstone, 1968; Beckenham, St. Paul's churchyard wall, 1968, *Wallace;* Bromley, College Slip, scarce on mortar of old brick wall, 1962-66; Bromley, Mavelstone Road, frequent on walls, 1957, one plant only, 1964; South Norwood Sewage Farm, scarce on concrete channels, 1963-64. **20:** Shirley, Devonshire Way, abundant on concrete at No. 204, 1968, *Wallace;* Shirley, Orchard Avenue, on cement at No. 35, 1967-68, *Wallace;* South Croydon, St. Peter's churchyard wall, 1968, *Wallace.* **21:** Beddington, Church Lane, scarce on old brick wall, 1968; Beddington, St. Mary's churchyard, occasional, 1961-64; Beddington Sewage Farm, frequent on concrete channels, 1962-68; Sutton, Benhilton, All Saints' churchyard, occasional, 1965. **22:** Beddington Sewage Farm, occasional on concrete channels, 1962-64; Merton, Dorset Road and Erridge Road, abundant on three asbestos-cement roofs, 1968; Merton, St. Mary's churchyard, scarce, 1961; Mitcham Watermeads, a few plants on mortar on brick channel-wall by small weir, 1966; Morden, St. Lawrence's churchyard, scarce, 1964-65; Wimbledon, St. Mary's churchyard, occasional, 1962. **24:** Kew, Royal Botanic Gardens, Herbarium Grounds, abundant on concrete top of fire hose depository and on asbestos-cement roof of spirit store, 1967, *Edwards* (Herb. Edwards); Richmond, wall near River Thames, 1956, *Gilbert* (Herb. Gilbert); Richmond Park, between Pen Ponds and Robin Hood Gate, Declinata Pond, "on brickwork of bridge over inflow stream", 1931, *Turrill*(K); Twickenham, Warren Footpath, frequent on wall near roller skating rink, 1956, *Gilbert* (Herb. Gilbert). **27:** Greenford, Holy Cross churchyard, one plant, 1967; Hanwell, St. Mary's churchyard, on headstone, 1967; Perivale, Horsenden Lane, Brown & Polson factory, uncommon on asbestos-cement roof of restaurant, 1968, *Edwards* (Herb. Edwards). **28:** Kingsbury, St. Andrew's churchyard, several plants on headstone, 1967. **29:** Little Stanmore, St. Lawrence's churchyard, occasional, 1965. **30:** East Barnet, St. Mary the Virgin's churchyard, occasional, 1968; Totteridge, St. Andrew's churchyard, occasional, 1957-64. **31:** Tottenham, All Hallows' churchyard, several plants on headstone, 1968. **32:** Cockfosters, Christ Church churchyard, occasional, 1968; Southgate, Christ Church churchyard, on two headstones, 1968.

[*P. tenella* (Scop.) DC. emend. Bitt.
Wood. Nitrophilous.
7: "Old pales at Blackheath. 1806", Herb. *J. E. Smith* sheet 1698.8 (LINN).]

[*Physciopsis adglutinata* (Flörke) Choisy (*Physcia elaeina* A. L. Sm.)
Bark. Nitrophilous.
13: Walthamstow, "on an apple tree in garden, Hoe Street", *Forster* (BM).]

Physconia grisea (Lamarck) Poelt (*Physcia grisea* (Lamarck) Zahlbr.)
Calcareous stone; formerly also on bark. Nitrophilous. Scarce. For distribution map see Fig. 2F.
19: Bromley, College Slip, scarce on mortar of brick wall, 1966. **21:** Beddington, Church Lane, scarce on mortar of old brick wall, 1958-68; Beddington, St. Mary's churchyard, scarce on headstones, 1961. **24:** Ham, scarce on old brick wall, 1966. **29:** Little Stanmore, St. Lawrence's churchyard, scarce, 1965. **29/30:** near Edgware, on bark, *Crombie* (BM).

[*P. pulverulenta* (Schreb.) Poelt (*Physcia pulverulenta* (Schreb.) Hampe)
Bark. Nitrophilous.
30: Totteridge, Herb. Sherard (OXF).]

Polyblastia albida Arnold
Calcareous stone. Probably overlooked.
21: Beddington, St. Mary's churchyard, 1965, *Laundon* 2513 (BM, slide coll., confirmed Swinscow).

P. dermatodes Massal. (*P. schraderi* A. L. Sm.)
Calcareous stone. Probably overlooked. New to the Area.
7: Lee Terrace, St. Margaret's churchyard, on chest-tomb, 1968, *Milne* (BM, det. Swinscow).

[*Protoblastenia immersa* (Hoffm.) Steiner (*Biatora immersa* (Hoffm.) Sydow; *Lecidea calcivora* (Schaer.) Massal.; *L. immersa* (Hoffm.) Ach.; *Lichen immersus* Weber (1778), non Huds. (1762))
Calcareous stone.
6: Charlton Wood chalk-pit, *Cooper* (1836, p. 58).]

P. rupestris (Scop.) Steiner
Calcareous stone. Rare.
22: Wimbledon, St. Mary's churchyard, scarce, 1956-64. **28:** Kingsbury, St. Andrew's churchyard, one plant on chest-tomb, 1967. **30:** Totteridge, St. Andrew's churchyard, scarce, 1964.

[*Ramalina evernioides* Nyl. (*Lichenoides lacunosum lacerum, latius & angustius* Dill. (1741, p. 163)

Bark.

21: Beddington and Carshalton, *Dillenius* (*op. cit.*, p. 164).]

[*R. fastigiata* (Pers.) Ach.

Wood.

20: Croydon, on fence, herb. *G. Davies* (BM).]

[*Rhizocarpon obscuratum* (Ach.) Massal. sensu lato (*Lecidea petraea* sensu Crombie, non (Wulf.) Ach.)

Acid pebbles.

13: Walthamstow, *Forster* in Crombie (1885, p. 67).]

[*Rinodina roboris* (Duf. ex Nyl.) Arnold (*Lichen sophodes* sensu Forster, non Ach.)

Bark. ?Nitrophilous.

13: Walthamstow, "on the Forest not far from Hale Brinks", *Forster* (BM).]

R. subexigua (Nyl.) Oliv. (*Lecanora exigua* auct. pro parte, non (Ach.) Fr.; *Rinodina demissa* auct., non (Flörke ex Körb.) Arnold; *R. salina* Degel.)

Calcareous stone; formerly also on acid stone. Nitrophilous. Occasional, chiefly on concrete, but also found on limestone and asbestos-cement sheeting.

2: Highgate Cemetery, scarce, 1956. **10:** Wandsworth Cemetery, scarce, 1956. **13:** Banbury Reservoir and sides of River Lea, abundant, 1968; Lockwood Reservoir, occasional, 1964; Walthamstow, on tiles, *Forster* in Crombie (1885, p. 63); Warwick Reservoir (east), abundant, 1968. **14:** Clayhall, Rushden Gardens, on asbestos-cement roof, 1966, *I. Tittley* (BM). **19:** Beckenham and Penge Grammar School, common on asbestos-cement roof, 1957, *Brightman* (1959, p. 104); Bromley, Mavelstone Road, frequent on walls, 1957-64; Crystal Palace, North Tower Gardens, on asbestos-cement roof and cement parapet of reservoir, 1958, *Brightman* (1959, p. 105); South Norwood Sewage Farm, occasional, 1963-64. **20:** Shirley, West Way Avenue, on concrete, 1969, *Wallace;* South Norwood Sewage Farm, abundant on concrete culvert pipes, 1963-64. **21:** Beddington, St. Mary's churchyard, occasional, 1961; Beddington Sewage Farm, locally frequent on concrete channels and bacteria beds, 1963-64; Worcester Park Sewage Farm, on concrete, 1966. **22:** Beddington Sewage Farm, frequent on concrete channels, 1963-64; Merton, St. Mary's churchyard, scarce, 1961; Mitcham, St. Peter and St. Paul's churchyard, 1961; Morden Hall Park, on plinth, 1961; Morden, St Lawrence's churchyard, occasional, 1961-64; Morden, Victory Avenue, on bird-bath at No. 14, 1961-69; Wimbledon, Arthur Road, on wall, 1956. **23:** Coombe Hill, on concrete, 1956; Hogsmill Valley Sewage Works, on concrete, 1966. **25:** Syon House Gardens, on plinth of column, 1958. **27:** Perivale churchyard, several plants, 1966. **28:** Paddington Cemetery, scarce, 1958. **31:** Banbury Reservoir, abundant, 1968. **32:** Banbury Reservoir and sides of River Lea, abundant, 1968.

Sarcogyne regularis Körb. (*Biatorella pruinosa* Mudd)

Calcareous stone. Scarce.

10: Streatham Cemetery, scarce on limestone memorial, 1968. **21:** Beddington, Church Lane, scarce on mortar of old brick wall, 1968.

22: Morden, Victory Avenue, on roof of shelter [now demolished] in garden of No. 14, 1960, *Laundon* 2189 (BM), on bird-bath at No. 14, 1964-69. **24:** Kew, Royal Botanic Gardens, on tunnel entrance wall of Temperate House, 1968. **30:** Totteridge, St. Andrew's churchyard, scarce on limestone, 1964.

Stereocaulon nanodes Tuck.

On soil on brick wall. Rare. New to the Area.

6: Greenwich, Maze Hill, common on brick wall, 1968, *Milne* (BM; Herb. Milne).

S. pileatum Ach.

Acid stone. Scarce, but usually in quantity at most localities.

6: Blackheath and Greenwich, Brooklands Park, Lee Road, Manor Way, Maze Hill, Morden Road, Morden Road Mews, locally abundant, 1968, *Milne* (Herb. Milne). **8:** Dulwich, abundant on disused brick tunnel wall at Crescent Wood Road, 1968. **19:** Beckenham, Cator Park, on tile, 1959, *Brightman.* **20:** Shirley, Cheston Avenue, Orchard Avenue and The Glade, abundant on rough brick walls, 1967, *Wallace;* South Croydon, St. Peter's Road, on wall of No. 5A, 1969, *Wallace;* **22:** Mitcham, Mitcham Park, abundant on walls of No. 48-54, 1965, *Laundon* 2494 (BM, confirmed Lamb). **24:** Barn Elms Reservoir, locally abundant on east side, 1965.

[*Teloschistes flavicans* (Swartz) Norm. (*Lichen vulpinus* auct., non L.; *Muscus aureus tenuissimus* Dill. in Ray (1724, p. 65); *Usnea capillacea citrina, fruticuli specie* Dill. (1741, p. 73))

Bark.

30: Totteridge, *Dillenius* in Herb. Synopsis (OXF).]

Thelidium decipiens (Nyl.) Kremp. (*T. immersum* Mudd)

Calcareous stone. Overlooked.

21: Beddington, St. Mary's churchyard, occasional, 1965. **29:** Little Stanmore, St. Lawrence's churchyard, scarce on chest-tomb, 1965.

T. incavatum Mudd

Calcareous stone. Overlooked.

21: Beddington, St. Mary's churchyard, occasional, 1965; Carshalton, All Saints' churchyard, scarce on chest-tomb, 1965. **30:** East Barnet, St. Mary the Virgin's churchyard, occasional, 1968.

[*Thelotrema lepadinum* (Ach.) Ach.

Smooth shaded bark.

13: Walthamstow, "hornbeams", *Forster* (BM).]

Toninia aromatica (Sm.) Massal.

Calcareous stone. Rare. New to the Area.

6: Charlton church, 1807, Herb. *J. E. Smith* misc. lich, coll. (LINN). **19:** Beckenham, St. George's churchyard, one plant on limestone headstone, 1968. **21:** Beddington, Church Lane, scarce on mortar of old brick wall, 1968.

[*T. caradocensis* (Leight. ex Nyl.) Lahm (*Lecidea caradocensis* Leight. ex Nyl.)

Wood.

30: Hendon, *Crombie* (BM); near Mill Hill, "on old palings", 1871, *Crombie* (BM).]

[*Usnea glabrata* (Ach.) Vain. (*U. hirta* sensu Cromb. (1885, p. 60) pro parte, non (L.) Weber)

Wood.

13: Walthamstow, "on a rail in our field", *Forster* (BM, det. Motyka).]

[*U. intexta* Stirt. (*U. hirta* sensu Cromb. (1885, p. 60) pro parte, non (L.) Weber)

Wood.

14: Walthamstow, "on a rail in our field", *Forster* (BM, det. Motyka).]

Verrucaria muralis Ach. (*Lichen schraderi* Ach. nom. illeg.; *Verrucaria rupestris* Schrad. (1794), non (Scop.) Weber (1780))

Calcareous stone. Probably not uncommon in the Suburban Ring, but overlooked.

19: Beckenham, St. Paul's churchyard wall, 1968, *Wallace*. **20:** South Croydon, St. Peter's churchyard, 1968, *Wallace*. **21:** Beddington, St. Mary's churchyard, on coped memorial, 1965. **22:** Morden, Victory Avenue, on calcareous stones in garden of No. 16, 1961, *Laundon* 2260 (BM). on concrete path of No. 14, 1963-64. **27:** Hanwell, St. Mary's churchyard, on chest-tomb, 1967. **30:** East Barnet, St. Mary the Virgin's churchyard, scarce, 1968; Finchley, Wildwood Road, abundant on coping in garden, 1956.

V. nigrescens Pers.

Calcareous stone. Local. Now confined to memorials in churchyards and cemeteries.

10: Wandsworth Cemetery, occasional, 1956. **12:** Brompton Cemetery, scarce, 1960. **13:** Walthamstow, "on walls", *Forster* in Crombie (1885, p. 69). **14:** Wanstead, St. Mary's churchyard, occasional, 1963; Woodford, St. Mary the Virgin's churchyard, occasional, 1967. **19:** Beckenham, St. George's churchyard, on chest-tomb, 1968. **21:** Beddington, St. Mary's churchyard, occasional, 1961-64; Carshalton, All Saints' churchyard, common, 1965. **22:** Merton, St. Mary's churchyard, scarce, 1961; Morden, St. Lawrence's churchyard, occasional, 1961-65; Wimbledon, St. Mary's churchyard, frequent, 1956-60. **25:** Chiswick Old Burial Ground, occasional, 1964. **27:** Greenford, Holy Cross churchyard, occasional, 1967; Hanwell, St. Mary's churchyard, occasional, 1967. **29:** Little Stanmore, St. Lawrence's churchyard, occasional, 1965. **30:** Gt. Northern London Cemetery, scarce, 1960; Hendon, St. Mary Magdalene's churchyard, occasional, 1968; St. Pancras and Islington Cemetery, scarce, 1957; Totteridge, St. Andrew's churchyard, abundant, 1957-64. **32:** Cockfosters, Christ Church churchyard, on chest-tomb, 1968.

V. viridula (Schrad.) Ach. (*Lichen tessellatus* Sm.)

On brick and calcareous stone. Rare.

The non-sorediate forma *viridula* is recorded from **13:** Walthamstow, "on walls", *Forster* (BM), and **21:** Beddington, St. Mary's churchyard, on ledge near base of limestone memorial, 1965. The sorediate forma *tectorum* (Massal.) Laundon is recorded from **22:** Beddington Sewage Farm, Hundred Acre Lane, common on concrete channels in illuminated situations, 1966, *Laundon* 2596 (LD) and 2604 (BM).

Xanthoria aureola (Ach.) Erichs. (*X. parietina* var. *aureola* (Ach.) Th. Fr.)

Acid and calcareous stone. Nitrophilous. Scarce. For distribution map of *X. parietina* (agg.)* see Fig. 2D.

19: Beckenham, St. Paul's churchyard wall, 1968, *Wallace*. **20:** Shirley, Devonshire Way, 1968, *Wallace;* Shirley, Wickham Road, on tiled roof, 1969, *Wallace*. **21:** Beddington Sewage Farm, several plants on concrete channels and on Irrigation Bridge, 1962-68. **22:** **22:** Beddington Sewage Farm, several plants on channels and on

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**Xanthoria parietina* (agg.) consists of *X. aureola* and *X. parietina* sensu stricto.

Hundred Acre Bridge, 1962-64; Morden, Victory Avenue, frequent on asbestos-cement roof of shed, 1961-68. **24:** Richmond Park, near Barnes Cemetery, "brickwork of culvert over ditch, Horse-paddock", 1930, *Ballard & Montford* (K). **27:** Greenford, Holy Cross churchyard, abundant on headstone, 1967. **30:** Totteridge, St. Andrew's churchyard, scarce on limestone headstone, 1964.

The following plants could not be determined beyond aggregate level because they were either devoid of both isidia and apothecia (see Laundon, 1967, p. 324), or were growing in places which did not facilitate close examination. They belong either to *X. aureola* or *X. parietina* sensu stricto, probably chiefly to the former:

19: Bromley, Mavelstone Road, occasional on wall, 1957-64; Crystal Palace, North Tower Gardens, numerous small plants on asbestos-cement roof [now demolished], 1958, *Brightman* (1959, p. 105); Elmstead Woods Station, frequent on brick wall, 1956, scarce, 1964. **20:** Shirley, asbestos-cement roofs, 1967, *Wallace;* South Norwood Sewage Farm, three plants on asbestos-cement roof, 1963. **21:** Beddington, Church Lane, several plants on old brick wall, 1958-68; Hackbridge, Culvers Avenue, on asbestos-cement roof of Avenue Cottage, 1968. **22:** Merton, Dorset Road and Erridge Road, on asbestos-cement roofs, 1968; Morden, Morden Court footbridge, one plant on concrete, 1968; Morden, Wandle Road, on roof, 1968. **24:** Ham, one plant on old brick wall, 1966; Ham Common, north-east part, north edge, on ground below wall of old shed, 1930, *Summerhayes & Milne-Redhead* (K); Richmond Park, on stonework of bridge over ditch west of Bog Lodge, 1930, *Summerhayes & Montford.* **29:** Little Stanmore, St. Lawrence's churchyard, scarce, 1965.

X. parietina (L.) Th. Fr. sensu stricto (*Physcia parietina* (L.) De Not.)
Bark, wood and stone. Nitrophilous. Scarce or extinct.

7: Blackheath, on wall, *Dillenius* in Herb. Sherard (OXF). **13:** Walthamstow, on trees, *Forster* (BM, with *Buellia canescens* and *Physcia adscendens*). **29/30:** near Edgware, on *Ulmus*, *Crombie* (BM). **North London:** on old pales in suburbs, *Crombie* in Trimen & Dyer (1869, p. 406).

[*X. polycarpa* (Hoffm.) Oliv. (*Psoroma polycarpus* (Hoffm.) Gray)
Wood. Nitrophilous.

7: "Old pales at Blackheath. 1806", Herb. *J. E. Smith* sheet 1698.8 (LINN).]

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REFERENCES

ABERCROMBIE, P., 1945. *Greater London Plan 1944.* London.
ANON. 1968. Air pollution. *Rep. Warren Spring Lab.*, 1966, 47-60.
BARKMAN, J. J., 1958. *Phytosociology and Ecology of Cryptogamic Epiphytes.* Assen, Netherlands.
BRIGHTMAN, F. H., 1959. Some factors influencing lichen growth in towns. *Lichenologist*, **1**, 104-108.

BRODO, I. M., 1966. Lichen growth and cities: a study on Long Island, New York. *Bryologist*, 69, 427-449.

BUCK, F. D., editor, 1964. Natural history of the garden of Buckingham Palace. *Proc. S. Lond. Ent. Nat. Hist. Soc.*, **1963** (2).

BURROWS, R., editor, 1950. *Halsbury's Statutes of England*, Ed. 2, **17**.

CHANDLER, T. J., 1965. *The Climate of London.* London.

CHANDLER, T. J. 1967. Absolute and relative humidities in towns. *Bull. Am. Met. Soc.*, 48, 394-399.

COOPER, D., 1836. *Flora Metropolitana.* London.

COPPOCK, J. T. and PRINCE, H. C., editors, 1964. *Greater London.* London.

CROMBIE, J. M., 1885. On the lichen-flora of Epping Forest, and the causes affecting its recent diminution. *Trans. Essex Field Club*, **4**, 54-75.

CROMBIE, J. M., 1894. *A Monograph of Lichens Found in Britain*, **1**. London.

DARBISHIRE, O. V., 1906. The wild fauna and flora of the Royal Botanic Gardens, Kew. 4. Lichenes. *Kew Bull.*, add ser., **5**, 102-103.

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH, 1945. *Atmospheric Pollution Research. Technical Paper No. 1. Atmospheric Pollution in Leicester. A Scientific Survey.* London.

DICKSON, J., 1790. *Plantarum Cryptogamicarum Britanniae*, **2**. London.

DILLENIUS, J. J. 1741. *Historia Muscorum.* Oxford.

GILBERT, O. L., 1968. Bryophytes as indicators of air pollution in the Tyne Valley. *New Phytol.*, **67**, 15-30.

GOODMAN, G. T. EDWARDS, R. W. and LAMBERT, J. M., editors, 1965. *Ecology and the Industrial Society.* Oxford.

HILL, J., 1759*. *Flora Britanica.* London.

HOLMES, E. M., 1878. The crytogamic flora of Kent. Lichens. *J. Bot., Lond.*, **16**, 117-120, 209-212, 329-345, 373-376.

HOOKER, W. J., 1833. *English Flora*, **5** (1). London.

HUDSON, W., 1762. *Flora Anglica.* Ed. 1. London.

JACKSON, B. D., 1881. *Guide to the Literature of Botany.* London.

JAMES, P. W., 1965. A new check-list of British lichens. *Lichenologist*, **3**, 95-153.

JAMES, P. W., 1966. A new check-list of British lichens: additions and corrections—1. *Lichenologist*, 3, 242-247.

JOHNSON, W., 1912. *Wimbledon Common, its Geology, Antiquities and Natural History.* London.

JONES, A. W., 1961. The vegetation of the South Norwood or Elmers End sewage works. *London Nat.*, **40**, 102-114.

JUNGE, C. E., 1963. *Air Chemistry and Radioactivity.* London.

LAUNDON, J. R., 1958. The lichen vegetation of Bookham Common. *London Nat.*, **37**, 66-79.

LAUNDON, J. R., 1967. A study of the lichen flora of London. *Lichenologist*, **3**, 277-327.

MALDEN, H. E., editor, 1902. *A History of the County of Surrey* (The Victoria History of the Counties of England). London.

MORISON, R., 1699. *Plantarum Historiæ Universalis Oxoniensis pars tertia.* Oxford.

NATIONAL SOCIETY FOR CLEAN AIR , 1964. *Sulphur Dioxide as an Atmospheric Pollutant.* London.

NATIONAL SOCIETY FOR CLEAN AIR, 1968. *Clean Air Year Book*, **1968-1969**.

PETIVER, J., 1695. *Musei Petiveriani.* London.

PEVSNER, N., 1952. *The Buildings of England. London except the Cities of London and Westminster.* Harmondsworth, London Borough of Hillingdon.

RAO, D. N. and LEBLANC, F., 1966. Effects of sulphur dioxide on the lichen alga, with special reference to chlorophyll. *Bryologist*, **69**, 69-75.

RAY, J., 1724. *Synopsis Methodica Stirpium Britannicarum.* Ed. 3. London.

RYDZAK, J., 1959. Influence of small towns on the lichen vegetation. Part VII. Discussion and general conclusions. *Annales Univ. Mariae Curie-Skodowska*, Sect. C, **13**, 275-323.

SEAWARD, M. R. D., 1966. Preliminary notes on the heathland lichen flora in the Scunthorpe area. *Lichenologist*, 3, 275-276.

SHAW, H. K. AIRY, editor, 1961. Additions to the wild fauna and flora of the Royal Botanic Gardens, Kew: XXIV. *Kew Bull.*, **15**, 169-191.

SKYE, E., 1958. Luftföroreningars inverkan pa busk—och bladlavfloran kring skifferoljeverket i Närkes Kvarntrop. *Svensk Bot. Tidskr.*, **52**, 133-190.

*Published either 1759 or 1760. See Jackson (1881, p. 232).

SKYE, E., 1964. Epifytfloran och luftflöroreningarna. *Svensk Naturv.*, 1964, 327-332.

SMITH, D. C., 1962. The biology of lichen thalli. *Biol. Rev.*, 37, 537-570.

SMITH, J. E. and SOWERBY, J., 1801. *English Botany*, 12. London.

TRIMEN, H. and DYER, W. T. T., 1869. *Flora of Middlesex.* London.

TURNER, D., 1804. VIII. Descriptions of four new British lichens. *Trans. Linn. Soc. Lond.*, 7, 86-95.

TURNER, D. and DILLWYN, L. W., 1805. *The Botanist's Guide through England and Wales.* London.

WILLIAMS, F. P., 1960. Pollution levels in cities. Reprint from the *Proceedings of the 27th Annual Conference, Harrogate, 5-7 October, 1960. National Society for Clean Air.* London.

WITHERING, W., 1792. *A Botanical Arrangement of British Plants.* Ed. 2, 3. London.

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The Behaviour of Common Carp *(Cyprinus carpio* L.*)* and Crucian Carp *(Carassius carassias* L.*)* as indicated by Angling Records.

By David Marlborough
(*Recorder of Fishes*)

INTRODUCTION

Moat Mount, the water considered here, has already been described (Marlborough, 1963 and 1967).

Angling results were used in the latter paper, and can be further analysed to yield information on the behaviour of the two Carps. Coulson (1968 and 1969) presents a similar exercise to the present one, on the Eel, *Anguilla anguilla* L. Beukema (1969a and 1969b) provides an experimental approach to Common Carp.

METHODS

The angling diaries used in Marlborough (1967) were used, but many of the earlier records were bare lists. Therefore only fuller records from August 20, 1956 to November 22, 1959, with some from the tagging experiment 1961 to 1962 (*q.v.*), were used. The variables considered for analysis were:

(*a*) Numbers, weights and species of Carp caught.
(*b*) Water temperature in degrees Fahrenheit and degrees Celsius.
(*c*) Number of hours spent fishing. Normally two rods were used.

Coulson (1968 and 1969) used "rod-hours", i.e. hours spent by each rod. The times of starting and stopping are recorded, and time spent by day or by night divided by official "lighting-up" time.

(*d*) Bites experienced—i.e. the total of indications clear enough for the angler to strike, fishes actually *taking* the bait. The fish hooked and lost are counted here also. These were few (*cf.* Beukema) because the average size of the fish was small (Marlborough, 1967) and the tackle adequate.

(*e*) Situation of the bait. Only two contrasting pairs of conditions could be taken:

(i) Either "weedy" . . . bait within a metre of large beds of *Potamogeton crispus;*
or "clear" . . . bait lying in open water more than one metre from *P. crispus* beds.

(ii) Either "top" . . . bait floating on the surface of the water. This was invariably cubes of bread crust. Only Carp were ever taken by this method;
or "bottom" . . . bait lying close to the bottom. The bait was normally bread, occasionally maggots or worms, presented by legering or float-fishing. Beukemar does not distinguish between baits either. Large enough pieces were used to deter most fish other than Carp.

OBSERVATIONS AND DISCUSSION

(*a*) *Temperature Behaviour.* More time was spent fishing in summer than in winter, so the hours taken to catch a fish at each temperature were calculated. The range of variation was considerable, especially because of the smaller sizes of the low-temperature samples: so the means of temperature ranges were considered (Table I).

TABLE I

Temperature Range °F	Temperature Range °C	Crucian Carp		Common Carp	
		Number of Fish	Hours per Fish	Number of Fish	Hours per Fish
32–40	0 – 4·5	0	0	0	0
41–50	5·0–10·0	17	2·5	3	14·5
51–60	10·6–15·6	16	2·2	5	7·1
61–70	16·1–21·1	23	12·9	74	4·0
71–80	21·6–26·6	2	7·8	9	1·7
OVERALL		58	6·8	91	4·3

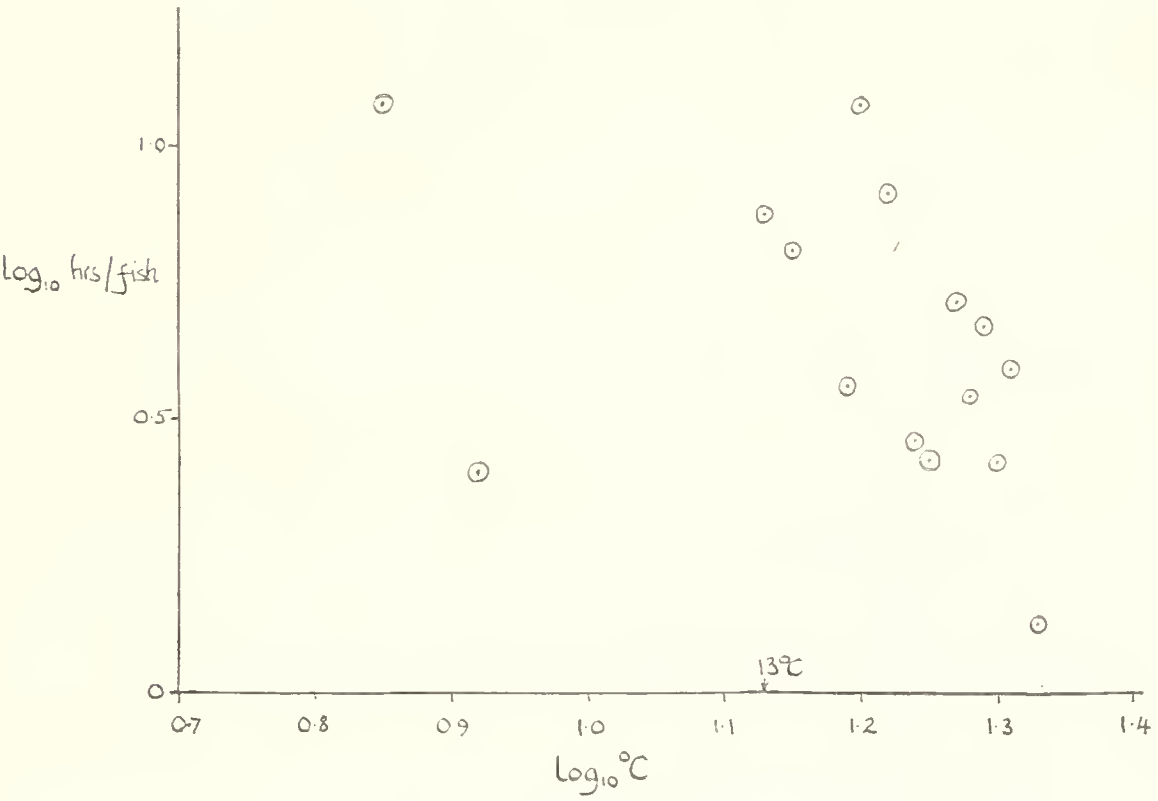
It is seen that most Common Carp are taken above 50°F (in fact 56°F), whereas Crucian Carp are caught throughout the range.

In the past it has been generally agreed that Common Carp either fast or reduce feeding at low temperatures (Moen, 1954; Grimalschi, 1939), though this generalisation is disputed by Gibbinson (1968). Walker (1952) further suggests that the feeding range of Common Carp lies between 58°F to 68°F (14·5°C to 20·0°C). This range is similar to that observed in Moat Mount, 56 to 71°F (13·3 to 21·6°C).

Maximum activity within a narrow temperature range is known as stenothermy. It seems Moat Mount Common Carp are mainly stenothermic.

Hours per fish in Common Carp decrease with increasing temperature. A plot for all readings of log hours per fish against log temperature °C for Common Carp shows this as well, confirming the more limited picture in Table I. The relationship is shown in Graph I.

Graph One
Common Carp.

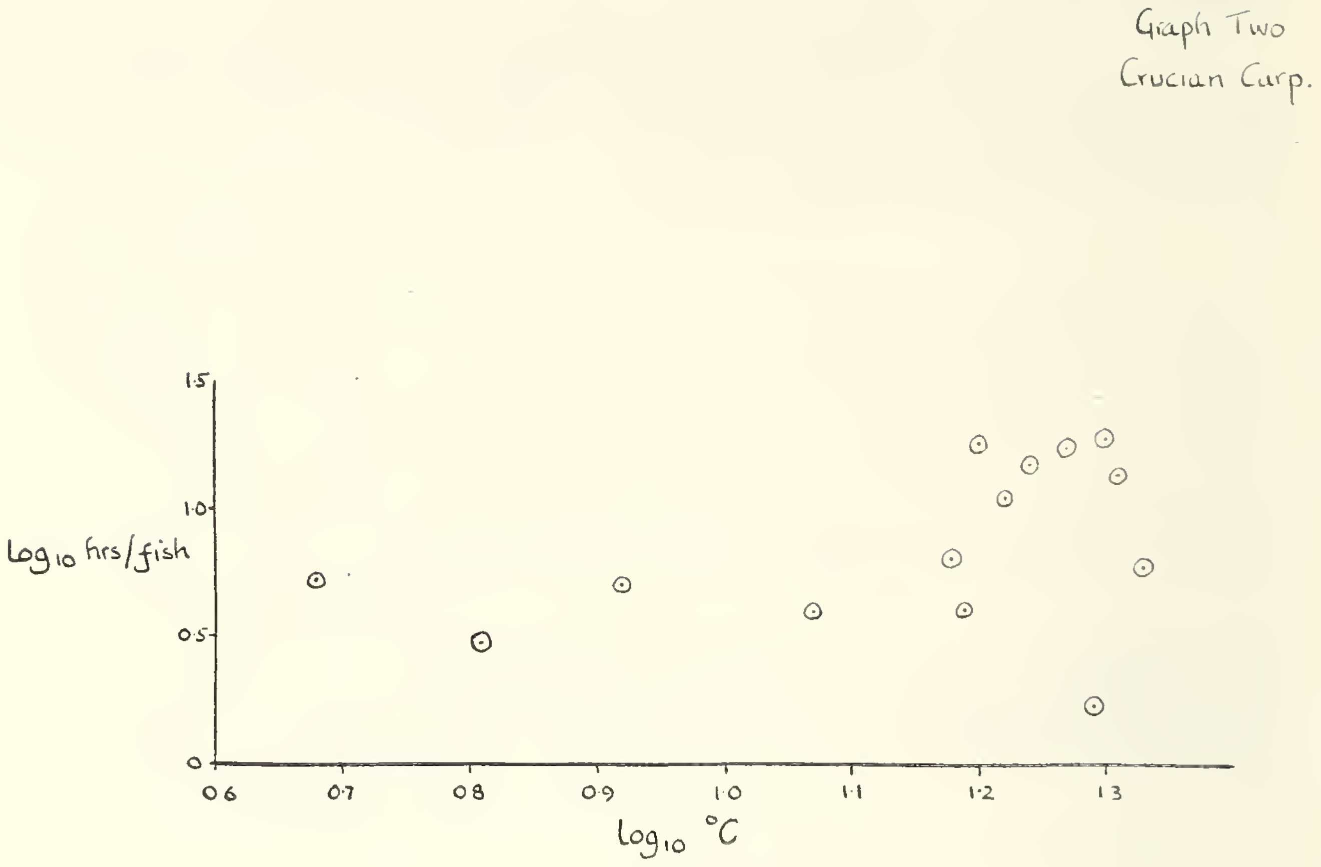


A negative regression line can be drawn of points over 13°C (54°F). There is no reversal, indicating that up to the limit of the observed temperatures, the activity of Common Carp is still increasing. The observed temperatures had not yet reached the "final preferendum" (Fry, 1957) for the Common Carp, found by Pitt, Garside and Hepburn (1956) to be 32°C (89·6°F).

Kubo (1936) notes an exponential function for the "feeding velocity" of the Japanese Eel, *Anguilla japonica*.

In Crucian Carp, numbers are found throughout the recorded temperature range, but hours per fish rises within the Common Carp's maximum-activity range. A logarithmic plot confirms this: the catch rate is roughly constant except where Common Carp are most active in Graph II. This *may* be due to inter-specific competition.

Eurythermism (activity over a wide temperature range) is not generally mentioned in the literature of Crucian Carp; it may be a characteristic of this population only. van Duijn (1956) compares the oxygen consumption of Goldfish and "Prussian Carp" (*Carassius* spp.) with that of Common Carp. His table (after Smolian, 1920) shows that oxygen consumption (a measure of overall activity) of these *Carassius* spp. is double



that of Common Carp at lower temperatures, and is not even approximately equal until 12·5°C (54·5°F), near the 56°F level previously noted. It has also been reported that a group of specialist anglers, the National Crucian Carp Specimen Group, catch Crucian Carp in winter in other waters (Seabrook, 1969).

There were not enough results to analyse temperature behaviour, etc. of different sizes of Carp in this way: but Meuwis and Heuts (1957) shows differences in reaction to temperature between Carp of different sizes.

(*b*) *Behaviour by Night and Day.* Table II was drawn up, of hours per fish for each species by night and by day.

TABLE II

Species of Fish		Day	Night	Overall
Crucian Carp	Number of fish	45	13	58
	Hours fished	302·5	96	398·5
	Hours per fish	6·7	7·4	6·9
Common Carp	Number of fish	36	55	91
	Hours fished	302·5	96	398·5
	Hours per fish	8·4	1·8	4·4

It is apparent that Crucian Carp are caught at about the same rate in both, but that these Common Carp are strongly nocturnal. It may be argued that they may, rather, be crepuscular—i.e. most active in the dusk.

But the division between "night" and "day" comes after a long "dusk" period—the "day" rate would be enhanced. Fishing experience shows that these Carp bite well from dusk until 02:00 hours. Coulson (1968 and 1969) shows a similar preference in the Eel, but uses an intermediate "twilight" period.

Such nocturnal preference may be true of this population only; but it is noted and discussed in Gibbinson (1968).

The overall figures for each species reflect their relative abundance (Marlborough, 1967).

(*c*) *Behaviour with other Variables.* No check was kept on the hours fished with the bait in weedy/clear water, or on top/bottom. The relative frequency of catching the two species was used to consider these in Table III.

TABLE III

		Weedy water	Clear water	Surface	Bottom
Day	Crucian Carp	5	39	6	48
	Common Carp	17	18	16	20
Night	Crucian Carp	2	12	10	13
	Common Carp	3	51	70	11

The "top" and "bottom" columns include fishes taken in the 1961-1962 tag scheme.

Crucians seem to be in clear water rather than near weeds by day, whereas Common Carp are taken in both. At night, very few of either are in the weeds—possibly because of carbon dioxide production in the dark? Differences between the species are statistically significant by day, not so by night.

Common Carp seem more active on the surface by day compared with Crucian Carp. Surface activity increases in both species by night. Both relationships are statistically significant. Surface activity in Common Carp is well known (e.g. Walker, 1952), but Crucian Carp are normally regarded as largely bottom feeders (*ibid.*). Again, this may be true only of Moat Mount Crucian Carp, for other populations in the L.N.H.S. Area are much more confirmed bottom feeders.

(*d*) *Response to Angling.* Angling is the sampling method, but perhaps the Carps' reaction to baits may alter with their experience of them. Beukema (1969a and 1969b) shows in his experiments that Common Carp learn to avoid baits after only one experience of being hooked.

Moat Mount was heavily fished during the sampling period, as shown by the number of seasonal permits taken out (Cave, 1961). Table 4 was accordingly drawn up using angling seasons (June 15 to March 15).

TABLE IV

Angling Season	Number of Anglers (after Cave)	Crucian Carp Hours per fish	Common Carp Hours per fish
1956–1957	84	3·2	10·2
1957–1958	101	5·2	2·8
1958–1959	106	20·1	4·03
1959–1960	103	17·8	8·9

In both species the number of hours per fish increases: Common Carp 1956-1957 and Crucian Carp 1959-1960 are based on only 5 out of 91 and 3 out of 58 fish respectively.

Two reasons may be suggested for this. Either the number of bites from both species falls, or the fish take less boldly and are less likely to be hooked, the more experience of angling they encounter. Both may be checked in Table V.

TABLE V

Angling Season	Hours per "bite"	"E" (efficiency)
1956–1957	1·9	0·48
1957–1958	1·5	0·61
1958–1959	1·5	0·42
1959–1960	2·9	0·54

"E" (efficiency) is the ratio of fish taken to the bites experienced per session. Species are not considered separately, as one cannot know which Carp caused an unhooked bite. Nor, might one add, can you know whether it *was* a Carp biting, or some other species. But few other species were in fact taken; and the sessions when they were are not counted in these calculations. Other safeguards are discussed in "Methods".

The table in fact shows little change in either measurement, and no obvious trend. Probably there are too many variables in the situation (e.g. increasing angling skill at hooking the bites—I hope!), or too few fish and sessions in the sample.

(*e*) *Efficiency under various conditions*. The ratio "E" can be compared in a variety of conditions, as in Table VI.

TABLE VI

	Day	Night	Surface	Bottom	Weedy	Clear
"E" efficiency	0·54	0·57	0·59	0·57	0·70	0·51

The ratio is around 0·5 in the Table, except in "weedy" water. A possible reason could be lower visibility of the tackle in weeds to the fish: but then the "night" ratio would be enhanced. One would expect friction of weeds on the line to produce *more* abortive bites, not less—unless the friction was so great only the boldest bites were registered. Again, Common Carp are normally bolder biters than Crucian Carp (Walker, 1952), and from Table III, more abundant in weeds. Perhaps the Carps simply feel more secure in cover and bite more boldly: but from Table III again, would this apply to Crucians?

A final suggestion, that *Potamogeton crispus* weed is most abundant in Moat Mount during the warmer months, and the ratio may be temperature-dependent, can be checked by Table VII.

TABLE VII

Temperature °F	Temperature °C	Mean "E", efficiency
41–50	5·0–10·0	0·61
51–60	10·6–15·6	0·56
61–70	16·1–21·1	0·53
71–80	21·6–26·6	0·75

It shows that temperature does not apparently affect the ratio greatly, except in the highest and lowest ranges, with fewest sessions. Here, as with some of the other ratio tables, one may query whether a relationship is not masked by pooling figures from two species of such differing response to temperature and other conditions.

CONCLUSIONS

From this small observational sample, few firm conclusions can be drawn, though they may indicate lines of future work. This "creel census" (Lagler, 1952) also demonstrates various physiological and behavioural processes at work in the wild.

(*a*) The Common Carp of Moat Mount are stenothermic, their most active temperature range being comparable to those quoted by other authors. Within this range their activity is related logarithmically to temperature.

(*b*) Crucian Carp in Moat Mount are eurythermic, but with a reduced rate of capture at temperatures when the Common Carp are most active.

(*c*) Moat Mount Common Carp are markedly nocturnal in their feeding habits, unlike the Crucian Carp.

(*d*) Moat Mount Crucian Carp seem to spend the daytime in open water, whereas the Common Carp are taken in both weeds or clear water. Neither seem to favour weedy water at night.

(*e*) Common Carp in Moat Mount are frequent surface feeders by day and night, whereas Crucian Carp largely feed on the surface by night only.

(*f*) There is evidence that each fish needs longer to catch as time continues and angling pressure increases.

(*g*) Angling in weedbeds produces a higher proportion of bites where the fish is hooked.

REFERENCES

BEUKEMA, J. J., 1969a. The phenomenon of learning ability of different species of fish with regard to angling. *Proceedings of the Fourth British Coarse Fish Conference*, in press.

———, 1969b. Angling experiments on various strains of carp (domestic wild and hybrids). Comparison of strength and stamina of different strains. *Proceedings of the Fourth British Coarse Fish Conference*, in press.

CAVE, F. J., 1961. Personal Communication from Hendon Borough Engineer.

COULSON, T. M., 1968. A report on the 1967 session reporting scheme. *National Anguilla Club*.

———, 1969. A report on the 1968 reporting schemes. *Bulletin of the National Anguilla Club*, **5**, 63-112.

van DUIJN, C., 1956. Diseases of Fishes. *Water Life*, London.

FRY, F. E. J., 1957. Effect of Environment on Animal Activity. *Univ. Toronto Studies Biol.*, Ser. No. **55** (Publ. Ontario Fisheries Research Lab., No. 68).

GIBBINSON, James A., 1968. *Carp*. MacDonald, London.

GRIMALSCHI, V., 1939. Zur Frage der Ernahrung der Fische in den Deltagewassern wahrend der Winterziet. *Bull. Acad. Roumaine*, **21**, *Bucharest*, 206-210.

KUBO, I., 1936. Feeding velocity of the Eel *Anguilla japonica* in relation to water temperature and other environmental conditions. *Bull. Jap. Soc. Sci. Fisheries*, 4, 335-338.
LAGLER, K. F., 1952. *Freshwater Fishery Biology*. Wm. C. Brown Co., Dubuque, Iowa.
MARLBOROUGH, D., 1963. The surface temperature variations of a small Middlesex pond. *The Naturalist*, April/June, 63-68.
———, 1967. Some studies on Common Carp (*Cyprinus carpio* L.) and Crucian Carp (*Carassius carassius* L.) in a small Middlesex pond. *Lond. Nat.*, 46, 76-81.
MEUWIS, A. L. and HEUTS, M. J., 1957. Temperature dependence of breathing rate in carp. *Biol. Bull. Woods Hole*, 112, 97-107.
MOEN, T., 1954. Food habits of the carp in three Northwest Iowa Lakes. *Proc. Iowa Acad. Sci.*, 60, 665-686.
PITT, T. K., GARDSIE, E. T. and HEPBURN, R. L., 1956. Temperature selection of the carp (*C. carpio* Linn.). *Canad. J. Zool.*, 34, 555-557.
SMOLIAN, K., 1920. *Merkbuch der Binnenfischerei*. Berlin.
WALKER, Richard, 1952. *Still Water Angling*, Macgibbon and Kee, London.
SEABROOK, G. S., 1969. Personal communication.

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Observations on the Return of Fishes to a Polluted Tributary of the River Thames 1964-9———

Observations on the return of fishes to a polluted tributary of the River Thames 1964-9

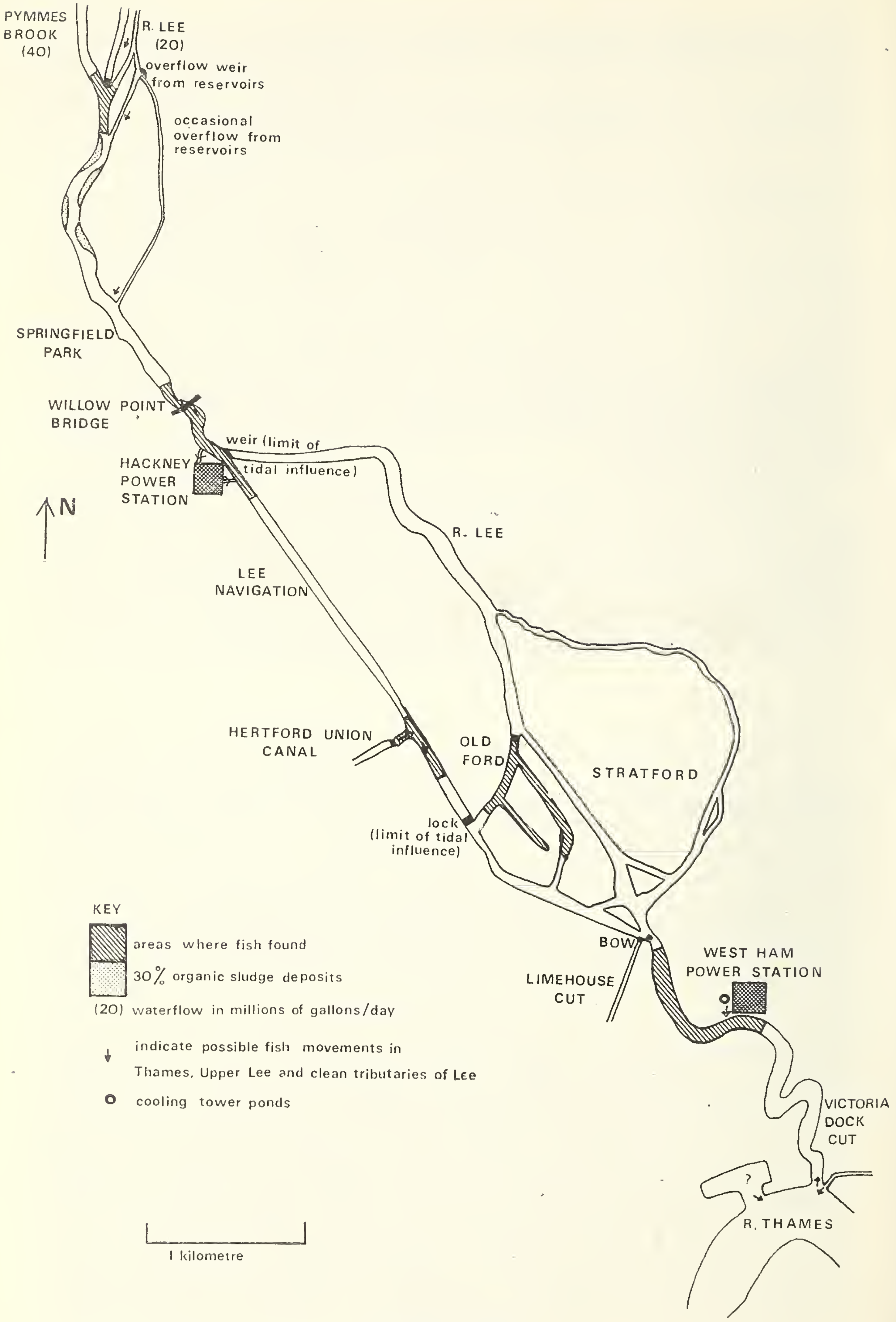
By B. S. Meadows

THE River Lee is a major tributary of the Lower Thames and during the 19th century appears to have supported a fish fauna typical of unpolluted lowland chalk streams (references quoted in Wheeler, 1958). With increasing industrial development of the lower catchment area in the early 20th century there occurred a parallel deterioration in water quality and the lower reaches of the River Lee became fishless (Pentelow, 1955). Surveys carried out by staff of the Lee Conservancy Catchment Board during the mid-sixties showed that the principal cause of pollution in the lower reaches of the river is the discharge from Pymmes Brook which enters the River Lee at Tottenham Hale (Grid Ref.: TQ 347890). The Pymmes Brook receives run-off from a number of small tributaries, which drain heavily built-up areas, and also contains the effluent from the Greater London Council's Deephams Sewage Works at Edmonton. This works treats a dry weather flow of 40 million gallons per day to the Royal Commission standard of 30 p.p.m. and 20 p.p.m. for suspended solids and biological oxygen demand, respectively. Upstream of the confluence with Pymmes Brook the River Lee is unpolluted but due to abstraction of most of the flow in its upper reaches for public water supply the dry weather flow rarely exceeds 20 million gallons per day and this is insufficient to adequately dilute the Pymmes Brook discharge with the result that serious pollution is detectable downstream. The two parameters which seem to be the limiting factors in the development of a viable coarse fishery in the River Lee are low oxygen and occasional high free ammonia concentrations. The latter appears to have been due to spent ammoniacal liquor from gas works being discharged into Deepham's sewers. There has, however, been an improvement during recent years and this has occurred because of remedial measures which have been undertaken by local authorities and industrialists in treating waste waters to higher standards (Lee Conservancy Catchment Board, 1967-70). The improved conditions have resulted in a return of certain species of fish to the Lower Lee.

Although I have made qualitative observations on the return of the fish fauna throughout the tidal and non-tidal Lower Lee this short note deals only with the return of fishes in a section between Willow Point Bridge and Hackney Power Station (see Location Map), page 78. This section has been looked at by the author as part of a wider study on the effects of heated sewage effluents and as a result changes in the flora, invertebrate population and chemical quality have also been monitored.

THE RETURN

In 1964 conditions were still grossly polluting with free ammonia concentrations at times exceeding 65 p.p.m. and oxygen often less than 0·5 p.p.m. Apart from eels *Anguilla anguilla* the river was fishless. Three-spined sticklebacks *Gasterosteus aculeatus* were first found in the tidal section in 1965 and had reached the River Lee at Hackney during the same year. The origin of these fish and other native species has probably been by downstream migration from the upper reaches since the weir at Lea Bridge Road is an effective barrier for fish migrating upstream from the tidal reaches and until 1969 there was a highly septic, fishless zone in the canalised section between Old Ford Lock and Hackney Power Station. In 1966 Mr. R. Harris obtained a specimen of the South American Guppy *Poecilia reticulata* and subsequent collecting by the author showed that a resident breeding population had been established at Hackney (Meadows, 1968). There has been at least one previous record of this species becoming established in a wild state in the British Isles (Dumbill, 1967). In 1968 further improvement in oxygen levels occurred and bleak *Alburnus alburnus*, roach *Rutilus rutilus* and gudgeon *Gobio gobio* became established. Bleak appeared to be most numerous of these three species and on one occasion I was able to collect over 300 individuals with a small handnet in two hours. Perch *Perca fluviatilis* did not become resident until the oxygen concentration was always well above 1 p.p.m. and this supports experimental work on the higher oxygen requirements of this species as compared with the other species that have colonised the River Lee at Hackney (References quoted in Jones, 1964).


PYMMES BROOK (40)
R. LEE (20)
overflow weir from reservoirs
occasional overflow from reservoirs
SPRINGFIELD PARK
WILLOW POINT BRIDGE
weir (limit of tidal influence)
HACKNEY POWER STATION
N
R. LEE
LEE NAVIGATION
HERTFORD UNION CANAL
OLD FORD
STRATFORD
lock (limit of tidal influence)
KEY
areas where fish found
30% organic sludge deposits
(20) waterflow in millions of gallons/day
indicate possible fish movements in Thames, Upper Lee and clean tributaries of Lee
cooling tower ponds
BOW
LIMEHOUSE CUT
WEST HAM POWER STATION
VICTORIA DOCK CUT
?
R. THAMES
1 kilometre

Location Map.

Recent work on the tolerance of eggs of perch to thermal pollution may also limit breeding success at this particular site if the high temperatures recorded during 1964-9 are maintained (see Swift, 1965). Table 1 summarises the salient chemical changes during the study period and these can be compared with the fish records. It can bee seen from this table that the Lee is unlikely to have been a significant source during the *early* recolonisation of the Thames (Wheeler, M.S. 1969).

TABLE I

List of fish found at Hackney Grid Ref. TQ 356866

			Fish fauna	
Year	Dissolved oxygen* Minimum values in p.p.m.	Free Ammonia* Maximum values in p.p.m.	Taken in all quarters of the year and spawn and/or fry observed	Taken on at least one occasion (adults only)
1964	<0·5	65		
1965	<0·5	50		*Gasterosteus aculeatus*
1966	<0·5	20	*Gasterosteus aculeatus* *Poecilia reticulata*	*Rutilus rutilus*
1967	<0·5	20	*Gasterosteus aculeatus* *Poecilia reticulata*	*Rutilus rutilus* *Alburnus alburnus*
1968	1	20	*Gasterosteus aculeatus* *Poecilia reticulata* *Rutilus rutilus* *Alburnus alburnus*	*Gobio gobio* *Perca fluviatilis*
1969	5	15	*Gasterosteus aculeatus* *Poecilia reticulata* *Rutilus rutilus* *Alburnus alburnus* *Gobio gobio* *Perca fluviatilis*	*Leuciscus cephalus* *Leuciscus leuciscus* *Nemacheilus barbatula*

NOTES.—The River Lee at Hackney is about 19 metres wide with a maximum depth of about 2·5 metres. Due to the discharge from Hackney Power Station, which uses river water for cooling purposes, the temperature is usually raised about 9 degrees Centigrade above normal river temperature. Weekly temperature readings have shown that the river normally has a range between 16 and 30 Centigrade. The riverwater has a total hardness of 300 p.p.m. (as $CaCo_3$), a bicarbonate alkalinity of 250 p.p.m. (as $CaCo_3$), an average total dissolved solids of 720 p.p.m. and a pH value of 7·8.
p.p.m. = parts per million.

*Chemical data mainly from Lee Conservancy Catchment Board, 1967-70.

Between 1964-7 the *only* invertebrates that I found in bed samples as distinct from collections made from growths of filamentous green algae (Chlorophyceae), which have been found growing on the banks of the river since at least 1964, had been oligochaet worms. These worms, which may occur at densities greater than 20,000 individuals per square metre, are still the most abundant bottom invertebrates but since 1967 funnel-leaved pondweed *Potomogeton pectinatus* and more recently *Ceratophyllum demersum* have colonised the river and spread rapidly. This has resulted in a parallel increase in the diversity of macro-invertebrates and over 20 species have now been taken from Hackney. Table II gives some examples of some invertebrate populations obtained. Fish that have been seen feeding within the pondweed beds include three-spined sticklebacks, bleak, roach, gudgeon and stone-loach *Nemacheilus barbatula*. It is of interest that all stone loach so far collected have all been within the pondweed beds. As pointed out by Marlborough, (1969) this species is usually found under stones and this is its normal habitat in the upper reaches of the River Lee.

TABLE II

Numbers of selected animals collected from one square metre of river bed in Spring and Autumn of 1968/9 by a standardised netting technique.

Station Lee at Hackney—Grid Ref. TQ 356866.

	1968		1969	
	Spring	*Autumn*	*Spring*	*Autumn*
Hirudinea (Leeches):				
Erpodella octoculata	2	0	0	11
Glossiphonia complanata	0	0	0	1
Haemopis sanguisuga	51	19	35	25
Crustacea:				
Asellus aquaticus	350	1300	39	2589
*Gammarus pulex**	0	0	0	25
Insecta:				
Odonata:				
Short-bodied dragonfly nymphs	0	0	1	1
Damsel-fly nymphs	3	11	18	33
Ephemeroptera:				
Mayfly nymphs	0	0	0	1
Coleoptera:				
Beetle larvae	7	0	3	2
Diptera:				
Midge larvae	—	—	—	1000
Mollusca:				
Bithynia tentaculata	0	0	2	5
Limnaea pereger	15	450	0	500
Limnaea stagnalis	0	0	0	3
Planorbis carinatus	0	0	9	2
*Physa fontinalis***	15	55	27	70

*The first gammarids were obtained after floods in 1969. None during the first quarter of 1970.
**At least one other species of *Physa*, possibly the introduced Mediterranean species *Physa acuta*, also occurs at Hackney but specimens have not yet been critically examined.

Little work has been undertaken on the parasites of fish from Hackney. Most of the adult roach examined have been infected with metacercaria of *Diplostomum spathaceum* and in 1968 at least 10% of the total bleak population seemed to be affected with fin-rot. This outbreak caused complete degeneration of the caudal fin in all the diseased fish. Guppies were also affected but sticklebacks and gudgeon were not observed with any symptoms of the disease. Free-swimming individuals of *Argulus sp.* have been taken during net sampling and in 1969 a number of sticklebacks were carrying this ecto-parasite.

THE FUTURE

Locally, such as where the physical character of the river causes the flow to be very sluggish and where little surface reaeration occurs, there are still extensive mud deposits. The section of the river between Tottenham Lock and Springfield Park is a case in point. The oxygen demand of these mud deposits, which may contain over 30% organic matter, can still create foul conditions in the River. Statistical analysis of the suspended solids balance in the river system has been undertaken and this has showed that a large proportion of the load of solids in the River Lee

Navigation could be attributed to the effluent from the above mentioned sewage works (Lee Conservancy Catchment Board, 1970). Current research on the river is being aimed to discover if the solids have settling and oxidising properties which can account for the low oxygen concentration at certain points along the river and where the fish fauna is still limited. Up to the present time the bottom muds have been essentially only inhabited by oligochaet worms but if these are colonised by extensive populations of chironomid midge larvae as they almost certainly will be if any further improvement in the oxygen levels at the mud-water interface occurs a further problem could arise. Like oligochaet worms the chironomids, by their irrigational activities, increase the aerobic layers, but probably of greater significance is that after a mass emergence of flies the upper layers, which will consist mainly of tubes, can easily become bouyed upwards by gases produced during decomposition in the anaerobic bottom layers (see also Edwards and Owens, 1965). Such masses of floating sludge can have a very high oxygen demand and could possibly cause fish kills by de-oxygenation of the water in downstream areas where fish have already returned. The mud deposits are highly resistant to erosion despite their small particle size and mapping the deposits before and after heavy floods in early 1969, showed no significant change. The Lee Conservancy Catchment Board thus consider that the suspended solids load must be reduced and are recommending that the Deephams Sewage Works is extended further so that the effluent can comply at all times with a far more stringent standard than the present consent conditions and that consideration should also be given to a proposal to dredge the existing bottom deposits. These further improvements are considered by the Board as absolutely essential if this part of the River Lee is to maintain and improve upon its new fishery.

ACKNOWLEDGEMENTS

It is a pleasure to acknowledge the work of the author's former colleagues on the staff of the Protection of Water Department of the Lee Conservancy Catchment Board who carried out much of the analytical work referred to in this paper. The biological work was a private study, but I owe a great debt to the Protection of Water Officer, Mr. R. G. Toms, B.Sc., F.R.I.C., M.Inst.W.P.C., M.I.P.H.E., for training in the field of river pollution control.

Mrs. P. A. Moxey was responsible for drawing the map.

REFERENCES

DUMBILL, P., 1967. *British Ichthylogical Society Monthly Newsletter, March 1967:* **1**.

EDWARDS, R. W. and OWENS, M., 1965. The oxygen balance of streams. In *Ecology and the Industrial Society*. Oxford.

JONES, J. R. E., 1964. *Fish and river pollution*. London.

LEE CONSERVANCY CATCHMENT BOARD, 1967-70. *Reports for the years ending March 31, 1965-69 inclusive*. London.

MARLBOROUGH, D., 1969. Further London Fish Records to 1968. *Lond. Nat.*, 48, 76-85.

MEADOWS, B. S., 1968. On the occurrence of the Guppy *Lebistes reticulus* in the River Lee. *Essex Nat.*, 32, 186-189.

PENTELOW, F. T. K., 1955. Pollution and Fisheries. *Verh. int. Ver. Limnol.*, **12**, 768-71.

SWIFT, D. R., 1965. Effect of temperature on mortality and rate of development of the eggs of the pike (*Esox lucius* L.) and the perch (Perca fluviatilis L.). *Nature, Lond.*, **206**, 528.

WHEELER, A. C., 1958. The fishes of the London Area. *Lond. Nat.*, 37, 80-101.

WHEELER, A. C., M.S. 1969. Progress report on the survey of the fishes of the Lower Thames. Privately published.

A Review of the Macrolepidoptera of the London Area for 1968 and 1969

By C. G. M. de Worms

THE present biennial review of the Macrolepidoptera in the London Area is a sequel to the rather short treatise covering 1966 and 1967 which appeared in the *Lond. Nat.* (**48,** 121-124) and of rather a longer version which was published in the *Proc. of the British Ent. and Nat. Hist. Soc.* (**1,** 113-123, December 1968).

As in previous similar reviews all aspects of the butterflies and the larger moths of the Area will be taken into consideration mainly for each of the Vice-Counties which the Area embraces together with the more outstanding captures and especial mention of those species which have been specially abundant or somewhat unaccountably absent for the period covered. The weather is mainly, if not always one of the chief factors in regulating the appearance and often the relative abundance of most of our insect fauna and not least the lepidoptera so that a brief survey of the two respective seasons would seem advisable at the outset.

The year 1968 was indeed a most capricious one with a very cold spell during the opening months and early spring. It was not till the season was halfway through that some really summer warmth supervened, for it was on the first of July of that year that the thermometer reached 90°F in the shade. It was immediately followed by the famous dust storm alleged to emanate direct from the Sahara and by a remarkable immigration of a number of species of lepidoptera which were supposed to have accompanied the storm and have been wafted to our shores. Quite a few of these migrants reached the London Area. This was the highlight of 1968 of which the late summer was far from settled or warm, a great contrast to 1969 which also opened very bleakly from February to May. But during the second half of June a fine spell began which continued almost unbroken throughout July and halfway through August. This summer period proved to be one of the best for butterflies for a long time. The other chief weather feature for 1969 was the record warm and dry October which brought in another quite phenomenal immigration of several migrant species together with quite a proportion of unusually rare ones which were also recorded in the Area.

As in the past quite a number of residents in the Area and also other collectors have gone to a great deal of trouble to send in their records and observations, sometimes in long annotated lists covering both seasons and I would like at the outset to express my sincere thanks and appreciation to them for their individual efforts which are fully incorporated in these ensuing pages.

Coming to the record of the more outstanding captures and sightings for 1968 and 1969 the light-trap which was run as before at intervals in the garden of Buckingham Palace does not appear to have attracted anything of special note as it has for previous seasons. Reference has already been made to the amazing spell of continuous weeks of warmth, chiefly during July 1969 and the spate of butterflies that accompanied it, not least of *Apatura iris* L. (the Purple Emperor) which had one of its most prolific years this century and it is gratifying that it reappeared again in the Area. For on July 5, Dr. Geoffrey Beven happened to be walking on

Bookham Common when he espied a male of this grand butterfly busily feeding on some excrement on the ground. He rushed for his camera to find it still gorging and he was able to take a superb and possibly unique photograph in colour of this splendid insect in its natural haunts. I am not aware of this species being seen on the Common since a pair was spotted there in 1952. The Area had its quota of several other butterflies that were especially numerous during 1969, notably *Pyrameis cardui* L. (the Painted Lady) which was abundant over most of the British Isles, even in the Orkney Isles. Many were noted throughout the Area and even in Inner London. That charming little insect *Celastrina argiolus* L. (the Holly Blue) reappeared in some plenty, mainly during the summer of 1969 with a number of sightings in the Area. A notable record by Mr. G. H. Gush on the fringe of the region at Thorpe in north-west Surrey was *Strymonidia w-album* Knoch (the White-letter Hairstreak) which seems to be quite a new locality for this small butterfly. Red Admirals, Peacocks and Small Tortoiseshells were reported in great numbers all over the Area in the late summer of 1969.

As regards the moths as usual there were a series of exceptional and some most unexpected records for the two years. Mention has been made of the two remarkable spells for migrants in July 1968 after the Saharan dust storm and again in the dry October of 1969. During the former period there was quite an incursion of the tiny noctuid *Eublemma parva* Hübn. (the Small Marbled), one of which found its way into the moth-trap of Mr. E. W. Classey on July 21, 1968 near Hanworth in Middlesex. There are apparently only two previous records of this species for the Area. Another most interesting capture for 1968 was on October 4 when Mr. C. G. Bruce took at light at Lee, Lewisham *Leucania unipuncta* Haworth (the White-speck Wainscot) of which is only one other for the Area, near Sutton in 1963. This insect is seldom seen inland as is *Leucania albipuncta* Hübn. (the White-point Wainscot) which Mr. Bruce also noted at Lee on August 8, 1969. Of this insect too there appears to be only two others recorded for the Area. September of this year also brought several other most outstanding visitors. On September 8, Mr. T. G. Haworth took a specimen of *Rhyacia simulans* Hufn. (the Dotted Rustic) at Totteridge, Herts, a moth with only two other records with one at Whetstone in 1963. Mr. R. I. Lorimer who also lives near Totteridge seems to be favoured with good fortune each year. On September 14, 1969 there was in his trap a melanic *Catocala nupta* L. (the Red Underwing) referable to *ab nigra* Cockayne, an extremely rare form of which he had another example there in 1962 so that it is evidently a stable locally recurring variety. Three days later a fine *Heliothis armigera* Hübn. (the Scarce Bordered Straw) also graced his trap. It is always a most uncommon migrant which seldom visits the Area. This month also saw the most remarkable capture of the biennial period with an insect entirely new to the British Isles which appeared in the moth-trap of Mr. Terry Dillon at Halsted near Sevenoaks just inside the south-eastern boundary of the Area. It is a small noctuid which has been expertly identified as **Plusia accentifera** Lefébvre, a denizen of most of Africa and the southern Mediterranean seaboard. It is quite likely this insect was a genuine migrant.

One of the chief features of the great October immigration was the prevalence of *Cosymbia puppillaria* Hübn. (Blair's Mocha) which was recorded almost all over southern England, sometimes several at a time.

At least two found their way into the London Area, one being noted by Mr. Bruce at Lee, Kent on the 20 of that month and another at Totteridge by Mr. R. Lorimer on the 22. There are some four earlier records for the Area of this little moth which was introduced to the British list in 1950. Another small geometrid which was comparatively abundant at this period was *Nycterosea obstipata* F. (the Gem) which appeared all over the southern counties with many observed in the London region. It was accompanied by another well-known migrant among the noctuids *Laphygma exigua* Hübn. (the Small Mottled Willow) which was equally prevalent in the Area. At this period too several of that very attractive small pale geometer *Rhodometra sacraria* L. (the Vestal) appeared in the South of England with a record in the heart of the Metropolis in Queen's Gate, South Kensington during October, 1969. But the most astonishing capture on the 29 of that month was an example of **Leucania l-album** L. (the White-L Wainscot) which Mr. J. A. C. Greenwood found at rest outside Claridge's Hotel in Central London. This insect which first was found in the south-western counties in numbers in 1933, has since colonised their coastline but does not appear to have spread eastwards of the Isle of Wight and never seems to leave its coastal habitat so that its appearance in the innermost London is problematical. It may be inferred that it was accidentally imported by some human agency. At any rate it is an entirely new species for the Area.

The larger Hawk moths are always a source of attraction and not least the most famous and spectacular *Acherontia atropos* L. (the Death's Head) which seems to be noted most years in the Area. One of these huge insects was taken on October 14, 1969 at rest on the wall of a school at Norbury by Mr. W. Lockyer, while another had its portrait in the local paper when located at Dartford in September 1968. But its relative, *Herse convolvuli* L. (the Convolvulus Hawk) which often appears as a migrant in the autumn, has been very scarce of late and seems to have deserted the Area during the past two years. The same can be said of *Macroglossa stellatarum* L. (the Humming Bird Hawk Moth) which sometimes visits our shores in vast numbers.

Among other less frequent species which inhabit the Area, particularly among the moths, there were several further records of *Hadena compta* Schiff. (the Varied Coronet) in Kent (K.16) and for Essex (E2.18), while both *Apatele alni* L. (the Alder Moth) and *Dicycla oo* L. (the Heart Moth) reappeared in Herts. (H.20). There were too still further records of *Amphipyra berbera* Runge (the Dusky Copper Underwing) from most of the Vice-County regions together with one bred from a larva found in Hyde Park. Our largest geometer was also observed in North London, *Boarmia roboraria* Schiff. (the Great Oak Beauty) in a melanic form, a most unexpected visitor to so near the centre of the Metropolis.

Analysing and recording for each of the respective Vice-County regions finds as before a number of species which had not been noted previously in them. This is due largely to the efforts of a number of local observers, though the Area has lost a few of the regular and ardent ones either through death or by leaving it. These new species as usual are designated by an asterisk*.

Starting with Inner London (I.L.) which often produces some startling records, not so many have been noted as usual for the two years under review. As to Buckingham Palace, the only unusual capture in the moth-trap run in the extensive grounds was *Earias clorana* L. (the Cream-bordered Pea), a very diminutive insect which appeared in 1968 and was also taken in 1953 in Regent's Park. Reference has already been made to the amazing capture of *Leucania l-album* L. (the White-L Wainscot)* at Claridge's Hotel in late October 1969, new to the Area and to I.L. *Rhodometra sacraria* L. (the Vestal) was another most interesting record from Queen's Gate in October 1969, though this species had been seen before in that part of the Metropolis, in 1947. The larva of *Amphipyra berbera* Runge (the Dusky Copper Underwing) taken in Hyde Park in May 1968 by Mr. D. J. Carter was of special interest since its breeding led to the reliable identification of the larva as compared with that of *A. pyramidea* L. (the Copper Underwing) with which it had been confused for so long (vide *Ent. Gazette*, 1969, **20**, 86).

Many of the Vanessid butterflies were seen in the centre of the Metropolis, especially in the autumn of 1969, in particular Peacocks, Red Admirals and Small Tortoiseshells, one of which was spotted fluttering about Liverpool Street Railway Station in May 1968 by Mr. A. J. Barrett who wondered if it may have had a free ride in from the outlying country, while a Red Admiral was observed flying along Euston Road in July 1968.

There were a good many interesting records for MIDDLESEX (M.21) for the two seasons. Among them the most outstanding was that of *Eublemma parva* Hübn. (the Small Marbled)* at Hanworth in July 1968 taken by Mr. E. W. Classey (*vide Ent. Gazette*, 1969, **20,** 46) who also reports from there in August 1968 *Parascotia fuliginaria* L. (the Waved Black) which also appeared in that area in 1954 and 1957. For 1969 Mr. Classey records from his trap at Hanworth *Leucania straminea* Treits. (the Southern Wainscot), not apparently seen in that part of M.21 since 1879. Another unusual visitor for July of that year was *Pyrrhia umbra* Hufn. (the Bordered Sallow) of which very few have been seen before in that part of M.21. On June 30, he had a female *Bupalus piniaria* L. (the Bordered White) also a rarity in that district, but 1969 was a year of general abundance for this species.

From North Harrow Mr. G. Prior records *Mania maura* L. (the Old Lady), *Zeuzera pyrina* L. (the Leopard), *Plusia iota* L. (the Golden Y) and the geometers *Dysstroma citrata* L. (the Dark Marbled Carpet), *Ellopia fasciaria* L. (the Barred Red), *Selenia tetralunaria* Hufn. (the Purple Thorn) and *Eupithecia innotata* (the Angle-barred Pug). From Ruislip Woods he reports *Melanthia procellata* Schiff. (the Pretty Chalk Carpet), *Bapta bimaculata* F. (the White Pinion-spotted), *Perizoma flavofasciaria* Thunb. (the Sandy Carpet), *Comibaena pustulata* Hufn. (the Blotched Emerald) and *Cosymbia linearia* Hübn. (the Clay Triple-lines), also *Chiasmia clathrata* L. (the Latticed Heath) from Harefield.

Mrs. Patricia Moxey who lives in the Muswell Hill district enumerated a number of captures in her house there during the two years. One of the most unexpected were two females of *Leucania pudorina* Schiff. (the Striped Wainscot)*, new to M.21, seen in July 1968. Mention has already been made to the couple of males and a female of *Boarmia roboraria* L. (the Great Oak Beauty) in August of that year, another exceptional visitor. Other noteworthy records from this locality include *Smerinthus ocellata* L. (the Eyed Hawk), *Apatele aceris* L. (the Sycamore), *Euplexia lucipara* L. (the Small Angle-shades), *Catocala nupta* L. (the Red Underwing), *Hemithea aestivaria* Hübn. (the Common Emerald), *Ennomos* *quercinaria* L. (the August Thorn), *Itame wauaria* L. (the V-moth) and many *Abraxas grossulariata* L. (the Magpie Moth). An interesting record in July 1968 from Hatch End was *Sterrha emarginata* L. (the Small Scallop), seldom a common little geometer.

Among butterflies a Painted Lady was seen at Ealing Common on July 24, 1969 by Mr. M. P. Walters, while Red Admirals were noted from mid-July to early October of that year at Wood Green by Mr. C. O. Hammond who also observed a good many Small Coppers, Wall Browns and Large Skippers there. Mr. R. Kettle records *Pararge aegeria* L. (the Speckled Wood) in September 1969 from Hampstead Heath where he also saw Small Coppers and Red Admirals in October.

For Herts. (H.20) Mr. R. I. Lorimer has as usual some outstanding records. The most notable in 1968 was *Hadena compta* Schiff. (the Varied Coronet)* which appeared at his home at Totteridge on July 6. This insect is steadily spreading in the Area and is a newcomer for H.20. Another uncommon little moth for this region seen in 1968 was *Eupithecia tantillaria* Boisd. (the Dwarf Pug). For 1969 the list is indeed remarkable. In addition to the melanic Red Underwing already referred to there was the *Cosymbia puppillaria* Hübn. (Blair's Mocha)* with only four previous records for the Area and none from H.20. It was taken on October 22, and coincided with the apparent immigration of this species to the South of England. A *Heliothis armigera* Hübn. (the Scarce Bordered Straw)* taken on September 17, was another addition to H.20 and a scarce migrant which also visited the British Isles this amazing autumn with several records.

Other migrants at this period included *Laphygma exigua* Hübn. (the Small Mottle Willow) in mid-October, as well as no less than nine of the small geometer *Nycterosea obstipata* F. (the Gem) which has been recorded several times before in that district. Other newcomers to H.20 were a *Leucania obsoleta* Hübn. (the Obscure Wainscot)* which appeared in early July, also *Euphyia unangulata* Haworth (the Sharp-angled Carpet)* and surprisingly the small noctuid *Rivula sericealis* Scop. (the Straw Dot)*, apparently quite a rarity in this part of Herts. Other records of note for 1969 by Mr. Lorimer were *Drepana cultraria* F. (the Barred Hooktip), nearly always associated with beech and new to Totteridge where *Dicycla oo* L. (the Heart Moth) reappeared after many years, while two examples of f. *nigrofulvata* of *Semiothisa liturata* Clerck (the Tawny-barred Angle) were also found. This melanic form seems to be becoming increasingly common in the Area and in the south of England. Mention has been made of the *Rhyacia simulans* Hufn. (the Dotted Rustic) also taken at Totteridge in September 1969 by Mr. T. G. Howarth with only one previous record for H.20.

Mr. Barry Goater once more has many interesting records for the two years from Bushey where new visitors to his garden there have been numerous. These include three *Apatele alni* L. (the Alder Moth) with an example of its melanic f. *steinarti* Caspari in 1968. A very scarce insect for H.20 but often an abundant one elsewhere was *Lycophotia varia* Vill. (the True Lover's Knot) which appeared in both years as did *Amathes ditrapezium* Schiff. (the Triple Square-spot). Other less common species for H.20 which he reports from near Bushey were *Clostera curtula* L. (the Chocolate-tip), *Cybosia mesomella* L. (the Four-dotted Footman), *Hadena lepida* Esp. (the Tawny Shears), *Rivula sericealis* Scop. (the Straw Dot) and *Laspeyria flexula* Schiff. (the Scarce Hooktip), all in single specimens during 1968. Among newcomers in the geometers were *Euphyia cuculata* Hufn. (the Royal Mantle), *Cosymbia linearia* Hübn. (the Clay Triple-lines), *Bupalus piniaria* L. (the Bordered White), *Abraxas sylvata* Scop. (the Clouded Magpie) and two Pugs new to H.20, *Eupithecia haworthiata* Dounbleday (the Haworth's Pug)*, and *Eupithecia fraxinata* Crewe (the Ash Pug)*. Other infrequent species reported by Mr. Goater, but previously on the Bushey list, comprise *Orthosia advena* Schiff (the Northern Drab), *Aporophyla lutulenta* Schiff. (the Deep Brown Dart), *Caradrina ambigua* Schiff. (the Vine's Rustic) all in 1968 and in 1969 *Laphygma exigua* Hübn., *Cosmia diffinis* L. (the White-spotted Pinion), *Zenobia subtusa* Schiff. (the Olive Kidney), *Selenia lunaria* Schiff. (the Lunar Thorn) and several *Nycterosea obstipata* F. Mr. Goater also took the newly-recognised *Amphipyra berbera* Rungs (the Dusky Copper Underwing) first in August 1968 at Bushey where it is apparently less common than *A. pyramidea* L.

Mr. G. Prior reports a number of interesting species, mainly geometers from the Rickmansworth area. These include *Comibaena pustulata* Hufn. (the Blotched Emerald), *Dysstroma citrata* L. (the Dark Marbled Carpet), *Electrophaës corylata* Thunb. (the Broken-barred Carpet), *Triphosa dubitata* L. (the Tissue), *Melanthia procellata* Schiff. (the Pretty Chalk Carpet), *Bapta bimaculata* F. (the White Pinion-spotted), *Nothopteryx carpinata* Borkh. (the Early Tooth-striped) and *Selenia tetralunaria* Hufn. (the Purple Thorn).

For SOUTH ESSEX (E2.18) Mr. K. M. Grimwood has once more sent in a most comprehensive list of his records at Ingrave, near Brentwood for 1968 and 1969, some of the species being new to this Vice-County region. Among the more interesting newcomers to his trap were *Mania maura* L. (the Old Lady), several *Harpyia bifida* Brahm. (the Poplar Kitten), also *Polia nitens* Haworth (the Pale Shining Brown)*, *Cosmia diffinis* L. (the White-spotted Pinion), with also a number of *Zenobia subtusa* Schiff. (the Olive Kidney), chiefly in 1969. Most of these insects had been noted from the Epping Forest area, but were new to this part of E2.18, while several surprising visitors were *Cucullia asteris* Schiff. (the Starwort Shark)*, not recorded before for E2.18 as were too the geometers *Anaitis plagiata* L. (the Slender Treble-bar)*, *Cosymbia albipunctata* Hufn. (the Birch Mocha)* and *Pseudoboarmia punctinalis* Scop. (the Pale Oak Beauty)*, all seen only in 1969. Other new records for this part of SOUTH ESSEX were single examples of *Cossus cossus* L. (the Goat Moth), *Hydriomena coerulata* F. (the May Highflyer), *Epione repandaria* Hufn. (the Bordered Beauty), *Horisme vitalbata* Schiff. (the Small Waved Umber), *Pseudoterpna pruinata* Hufn. (the Grass Emerald) with a number of *Colostygia didymata* L. (the Small Twin-spot Carpet), *Apocheima hispidaria* Schiff. (the Small Brindled Beauty) and *Arenostola pygmina* Haworth (the Small Wainscot).

The reappearance of some less common species was most heartening. Among these were *Hadena compta* Schiff. (the Varied Coronet), *Leucania obsoleta* Hübn. (the Obscure Wainscot), *Nonagria dissoluta* Treits. (the Brown-veined Wainscot), *Trichiura crataegi* L. (the Pale Oak Eggar), *Lasiocampa quercus* L. (the Oak Eggar) and *Saturnia pavonia* L. (the Emperor Moth). Mr. Grimwood mentions that species which have recently shown signs of being commoner in his district include *Amathes glareosa* Esp. (the Autumnal Rustic), *Griposia aprilina* L. (the Merveille-du-Jour), *Lygephila pastinum* Treits. (the Blackneck), *Sterrha vulpinaria* H.-S.

(the Least Carpet), *Bapta distinctata* H.-S. (the Sloe Carpet), *Plagisdo dolabraria* L. (the Scorch-wing) and *Apeira syringaria* L. (the Lilac Beauty). Among the butterflies there, Brimstones were particularly common in 1969 as were the Commas, Red Admirals, and *Celastrina argiolus* L. (the Holly Blue), but *Pararge aegeria* L. (the Speckled Wood) has not been seen since 1967.

There do not appear to be any significant records for NORTH ESSEX (E1.19).

For KENT (K.16), though there are fewer records than usual, nonethe less several are quite outstanding and pride of place must go to *Plasia accentifera* Lefèbvre* taken in September 1969 near the Area boundary at Halsted by Mr. Terry Dillon, as already mentioned in the introduction This insect new to Great Britain consistutes a major entomological event and addition to the London list. Hardly less spectacular was Mr. C. G. Bruce's capture at Lee of *Leucania unipuncta* Haworth (the White Speck Wainscot)* in October 1968, new to K.16. In August 1969 *Leucania albipuncta* Schiff. (the White-point Wainscot and *Cosymbia puppillaria* Hübn. (Blair's Mocha) in October 1969 are only the second records of each of these two insects for K.16.

Mr. D. O'Keefe who lives at Bexley lists 11 specimens of *N. obstipata* F. (the Gem) there in the autumn of 1969. Mr. Chalmers Hunt also took an example of this little migrant in that area. In July 1969 Mr. O'Keefe took *Hadena compta* Schiff. (the Varied Coronet) which has only recently colonised this part of KENT. He mentions that larvae of *Aporophyla lutulenta* Schiff. (the Deep Brown Dart) were especially common round Bexley in 1969, in the summer of which Mr. B. W. West took an example near Dartford of *Parascotia fuliginaria* L. (the Waved Black) which apparently has not been seen in this V.-C. area since the beginning of the century. Reference has already been made to the Death's Head Hawkmoth seen in Dartford in September 1968.

For SURREY (S.17) by far the most notable event was the reappearance in July 1969 of *Apatura iris* L. (the Purple Emperor) on Bookham Common where it had apparently not been seen since the early 1950's. Besides the male which Dr. G. Beven had the amazing good fortune to photograph while feeding on horse manure on July 5, at least two others were sighted, one on the 13 of that month and the other in early August on the Common.

Mr. G. H. Gush has once more sent in some interesting records for the Thorpe and Weybridge districts in 1969. The finding of a specimen of *Strymonidia w-album* Knoch. (the White-letter Hairstreak) near Thorpe adds a new locality for this attractive little butterfly which has become very scarce of late in S.17. He also had several sightings of *Thecla quercus* L. (the Purple Hairstreak) which is none too common in that part of SURREY. Other noteworthy observations for Thorpe included three *Limenitis camilla* L. (the White Admiral), another far from numerous butterfly in north-west Surrey. At least two dozen Painted Ladies were seen during July and August, but what was most remarkable was the number of *Colias croceus* Fourc. (the Clouded Yellow) appearing at Thorpe with quite 50 records and no less than 23 noted on August 16 especially as this great migrant had not been reported as plentiful in 1969. The Peacocks, Small Tortoiseshells and Commas were abundant in the area with a good showing of the Red Admiral seen migrating steadily in a south-eastern direction in October and even at the start of November. Meadow Browns, Gatekeepers and Ringlets were in hundreds there in high summer, while a few *Plebeius argus* L. (the Silver-studded Blue) were flying at St. George's Hill at Weybridge.

Among the large moths Mr. Gush records *Mimas tiliae* L. (the Lime Hawk) at Weybridge with *Sphinx ligustri* L. (the Privet Hawk) and a male *Saturnia pavonia* L. (the Emperor Moth) at Thorpe on May 11. He also mentions an *Acherontia atropos* L. (the Death's Head) at Walton-on-Thames on July reported by Mr. B. P. Barker which makes a second specimen of this famous insect for S.17 what with Mr. W. Lockyer's specimen at Norbury on October 14, 1969, already referred to.

For the Wimbledon district Professor J. V. Dacie again returns some very noteworthy records. In 1968 he took in his trap *Cybosia mesomella* L. (the Four-spotted Footman), not observed in that region since early in the century, also the tiny *Rivula sericealis* Scop. (the Straw-Dot), not recorded for Wimbledon. In 1969 several species reappeared of which only single examples had been seen before. These included *Atethmia xerampelina* Esp. (the Centre-barred Sallow), *Rhizedra lutosa* Hübn. (the Large Wainscot), *Ennomos quercinaria* Hufn. (the August Thorn) and *Nycterosea obstipata* E. (the Gem) while Mr. Philip Bowman reports *Euschesis interjecta* Hübn. (the Least Yellow Underwing) and *Plusia festucae* L. (the Gold-spot), all seldom seen in the Wimbledon area from earlier records.

From the Reigate region Mr. D. Trembath reports the appearance of *Apatele alni* L. (the Alder Moth) both in 1968 and 1969, a species only once noted previously from this part of S.17. *Lygephila pastinum* Treits. (the Blackneck), seen in 1968, is another uncommon insect in the area as was *Abraxas sylvata* L. (the Clouded Magpie) seen in July 1969. *Achlya flavicornis* L. (the Yellow Horned) is a futher apparently uncommon species in the district.

Nearer the centre of London Mr. S. Wakely has done a lot of light-trapping at his home in Camberwell where he records a large number of insects for both years. During August and September 1968 he reports several species not often seen in such a built-up region. These included *Scotogramma trifolii* Hufn. (the Nutmeg), *Hadena rivularis* F. (the Campion), *H. bicruris* Hufn. (the Lychnis), *Leucania conigera* Schiff. (the Brown-line Bright-eye), while in August and October 1969 *Thera obeliscata* Hübn. (the Grey Pine Carpet), *Deuteronomos fuscantaria* Haworth (the Dusky Thorn), *Eupithecia linariata* Schiff. (the Toadflax Pug) and *Eupithecia succenturiata* L. (the Bordered Pug).

Finally for Bucks. (B.24) Sir Eric Ansorge has had a specimen of *N. obstipata* F. (the Gem)*, apparently new to the V.-C. area, and an example of *Lithophane semibrunnea* Haworth (the Tawny pinion), also in October 1969, quite a rarity for B.24. *Discoloxia blomeri* Curtis (Blomer's Rivulet had not been seen in that part of the V.-C. since 1887. Other infrequent visitors to Chalfont St. Peter were *Eilema sororcula* Hufn. (the Orange Footman) and *Rhizedra lutosa* Hübn. (the Large Wainscot), all observed in 1969.

To summarise the total species of the Macrolepidoptera recorded for the London Area to the end of 1969 reaches 728 species out of a total of 934 recognised species for the British Isles comprising these groups of the Lepidoptera. The overall percentage for the Area is therefore remaining at 77·9%, the same as it was at the end of 1967.

Ladybird Survey—Second Report

By D. G. Hall

In 1968 the *London Naturalist* published details of a survey being undertaken by the Entomological Section into the status of six common species of ladybirds in the London Area. Briefly, six species listed in Table I are being studied in relation to locality, seasonal distribution and habitat. The first year's results, published last year (Hall, 1969), revealed a lack of records of the 7-spot and scarcity of ladybirds generally. It was decided, therefore, to continue the survey a second year in order to compare the results with the first.

Table I

Records of *Coccinellidae*

	1968 No.	1969 No.
Adalia bipunctata L.	517	372
Coccinella 7-punctata L.	7	128
Adalia 10-punctata L.	12	19
Coccinella 11-punctata L.	3	6
Propylea 14-punctata L.	13	20
Thea 22-punctata L.	12	15

It should be noted that apart from the increase in the number of records of *Coccinella 7-punctata*, the totals for each species in 1969 are of the same order of magnitude as for 1968. In addition to these records, Mr. and Mrs. Strangeman found 227 *Coccinella 7-punctata* in one afternoon on Box Hill which is just outside the Society's Area.

As in the previous year very little can be said about the 10, 11, 14 and 22-spot ladybirds as even in two years the numbers recorded have not yet reached 50 for any one species.

Brian Benham (Benham, 1969) remarked on the few records of *Coccinella 11-punctata* inland. It has certainly been the least recorded species in this survey and because of this details of each record are set out in Table II.

TABLE II

Records of *Coccinella 11-punctata* L.

Date	Place Locality	Habitat
April 2, 1968	Isleworth	In garden
June 3, 1968	Kingsbury	On *Anthemis* sp.
July 19, 1968	Isleworth	On *Tilia platyphyllos*
April 4, 1969	Cuffley	On ground
April 30, 1969	New Malden	On Station platform
July 26, 1969	Cheshunt	On clothes line
August 10, 1969	Cheshunt	On Asparagus
August 30, 1969	Ripple Level	Thameside marshes, Essex
September 11, 1969	Barnes Common	On *Artemesia vulgaris*

During the year Eastop and Pope (Eastop and Pope, 1969) published the results of six years work on ladybirds recorded at Kew. One of their tables sets out the numbers recorded during each month of the year.

Only a sufficient number of records of *Adalia bipunctata* were received in this survey to justify a similar distribution table (see Table III).

TABLE III

Monthly records of *Adalia bipunctata* L.

Year	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1968	–	–	129	40	121	185	70	4	2	3	1	–	555
1969	–	2	3	10	56	116	120	17	36	7	–	2	369
Total	–	2	132	50	177	301	190	21	38	10	1	2	915
Eastop & Pope 1963-68	–	–	11	61	263	569	464	132	49	6	–	–	1555

No doubt the records for November to February in the Society's survey relate to hibernating species. From the Table it will be observed that the Society's records bear comparison with Eastop and Pope. It should be remarked that the figures in the Society's survey include records from schools that have taken part. In consequence no records have been received after mid-July from this source. Furthermore, Eastop and Pope went on to record half yearly totals. From this they observed that there seemed to be alternate early and late ladybird years. Their figures are set out in Table IV for the period 1963-1968 and the Society's results added for 1969.

TABLE IV

Half-yearly records of *Adalia bipunctata* L.

Year	Jan.–June	July–Dec.
1963	47	48
1964	147	88
1965	50	202
1966	194	55
1967	84	152
1968	282	86
1969	187	182

Bearing in mind the non-receipt of records from schools who had been actively recording in June and early July the records for the Society's survey support this theory of alternate early and late ladybird years. Too much must not be read into these figures, however, as it will be noticed that the peak period for *Adalia bipunctata* is June or July anyway (see Table III). Eastop and Pope observed from their analysis that there was a month's difference in the period by which half the annual numbers were recorded.

Records for *Adalia bipunctata* were received from a further 42 monads making 95 out of a possible 2,765. There is still a long way to go before any observations can be made in respect to distribution. Records from Essex, Surrey and Kent would be particularly useful.

Coccinella 7-punctata L., generally regarded as common, calls for more research. Although 128 records were received last year, Eastop and Pope only found 15 at Kew in six years. Plants upon which the species were recorded by members are set out in Table V.

TABLE V

Plant associated with *Coccinella 7-punctata* L.

Plant	No.
Artemesia vulgaris	48
Cirsium spp.	15
Heracleum sphondylium	6
Achillea millefolium	5
Urtica dioica	3
Others	21

In view of the possible cycle in occurrence of *Adalia bipunctata* and the possibility of obtaining further information on the 7- and 11-spot ladybirds the ladybird survey will continue for a further two years.

I thank all members who have contributed records and so made this report possible.

For those who wish to participate in this and future years, aids to the identification of the species under review, and recording sheets may be obtained from my address, 7 Sutherland Avenue, Cuffley, Herts. It should be stressed that no detailed understanding of the subject is required and all members, whether entomologists or not, are invited to send in records.

LIST OF RECORDERS

J. Arkell, Dr. G. Beven, P. Charlton, D. Dunn, Mrs. M. C. Foster, Miss R. Grubb, R. W. Hall, Mrs. F. N. Harris, Mrs. J. Hayes, P. C. Holland, Miss B. Johnson (Green School for Girls), H. J. Killick, A. E. Le Gros, D. A. Lilliman, Mrs. J. Small, Mr. and Mrs. P. J. Strangeman, Miss D. M. Trevaskis, Miss D. E. Woods.

REFERENCES

——— Survey of Ladybirds occurring in the London Area. *Lond. Nat.*, **47**, 104.

BENHAM, BRIAN R., 1969. *Coccinella 11-punctata* at Feltham, Middlesex. *Entomologist*, **102**, 189.

EASTOP, V. F. and POPE, R. D., 1966. Notes on the Ecology and Phenology of some British Coccinellidae. *Entomologist*, **99**, 287-289.

———, 1969. Notes on the Biology of some British Coccinellidae. *Entomologist*, **102**, 162-164.

HALL, D. G., 1969. Ladybird Survey—First Report. *Lond. Nat.*, **48**, 124-125.

Survey of Bookham Common

TWENTY-EIGHTH YEAR

Progress Report for 1969

General. (G. Beven).

One of our most distinguished members, Mr. Leonard Parmenter, died during March 1969. In 1941, when secretary of the Ecology section, he was largely responsible for the inauguration of the survey, and he continued to take a great interest in it, making regular visits for some twenty years. He made a special study of the Diptera, on which he published a series of papers. Together with Montague Niblett he listed over 1,200 species of two-winged flies from the Common, more than from any other comparable area of the country! Even after his retirement to the New Forest he retained his interest in the Survey and was always ready to help with entomological problems. He will be greatly missed.

Mr. Parmenter's collection of Diptera (about 30,000 pinned specimens and also a very fine collection of leaf mines and his notebooks) has been presented to the department of Entomology, British Museum (Natural History) where his index of the Diptera of Bookham Common has also been deposited. A species of Pipunculidae Diptera new to science has been named after him *Chalarus paramenteri* Coe and has been found in Scotland (Dumbarton), Westmorland, Cheshire, Kent and Surrey. Two of the specimens were collected by L. Parmenter; 1♀ Bookham, Surrey June 26, 1960, and 1 ♀ Sevenoaks, Kent July 4, 1965. The species was described by Coe, R. L., 1966. "Some British species of Chalarus and Verrallia (Diptera: Pipunculidae)." *Proc. R. ent. Soc. Lond.* (B). **35,** 149-160.

Several more books and identification keys have been kindly given to the Research Centre's Library by A. E. Le Gros, who has also presented a B.D.H. pH meter.

A Nature Trail is to be organised for July 18-19, 1970, to show the structure of the oakwood and the spread of scrub and woodland on to the grassland. It will also include a visit to the Research Hut and the Isle of Wight pond.

On the whole the summer was warm and rather dry, the rainfall, June to October, being only 68% of the average. The period September–October was the driest such period since 1752, and October the warmest for over 100 years. The rainfall for the whole year however was 21 inches, 90% of average (1916-1950) (London, St. James).

The Carnegie Scheme. (H. A. Sandford).

The Carnegie United Kingdom Trust is helping to finance the Society's activities on Bookham Common. The grant of £280 is for a survey of the vegetation, soils and fresh waters and for their correlation. The Society has agreed to contribute up to £200 towards the cost of further equipment and expenses.

The first stage has involved a revision of C. P. Castell's topographical map which has been the basis of work on the Common since 1942, the production of a detailed schedule of work and the purchase of equipment.

The main task now awaits us. There is an urgent need for more help from members of the Society in this interesting project. No previous experience is needed, and anyone can take advantage of this opportunity to learn some modern survey techniques. Please join us at Bookham Common, or write to the Director, H. A. Sandford, Dept. of Geography, College of St. Mark and St. John, King's Road, S.W.10.

VEGETATION

Revision of the Flora (Ella M. Hillman).

Recording sheets have been prepared on which observers can record in which sections of the Common certain selected plants occur and it is proposed to examine these records to see if they give an indication of changes which have taken place since the flora of Bookham Common was compiled for the survey in 1953 (*Lond. Nat.* 1954. **33**, 25-47). The recording has proceeded steadily, through the efforts mainly of Miss J. Stoddart and Dr. A. S. Thorley, but lack of a sufficient number of botanists has meant that the data does not accumulate fast enough for an analysis to be begun yet.

A complete card index of punched cards for all the plants in the 1953 flora has been made, and by manual operation all species occurring in a given area or group of areas can quickly be extracted for purposes of analysis. Further data can be added to the cards, and this will be done when experience shows what is likely to be useful.

Notes on the Bracken and Scrub of the Plains in 1964. (C. P. Castell).

The distribution of Bracken and scrub in 1953 was shown by A. W. Jones (1954) in his vegetation map of Bookham Common.

At the suggestion of the writer, the bracken areas of the Plains were re-surveyed in 1964 by Mr. F. C. Reeves, who also made notes on the spread of scrub and prepared a sketch-map. Although it has not been found possible to prepare a map suitable for publication, a short account of the position in 1964 might be found useful for comparison with 1953 and the present time. This account is based on notes and the sketch map made by Mr. Reeves and, although written in the present tense, applies only to the position in 1964. This 1964 survey has shown that throughout the peroid 1953 to 1964 there has been some increase in bracken and a considerable increase in scrub in all the plains.

EASTERN PLAIN

This is almost totally covered with bracken. Castell and Jones (1958) stated that scrub appeared to be more strongly developed among the bracken than in the Molinietum; this is no longer so. Birches, with some aspens and willows, are spreading over the whole of the plain and only a small area of approximately two acres remains clear. The Molinietum immediately west of Tunnel Path is now covered with scrub, largely hawthorn (*Crataegus monogyna*); it is notable that this is the only part of Eastern Plain where hawthorn has developed. This is particularly so when it is contrasted with the adjacent Molinietum, of Jones' map, east of Tunnel Path which is now entirely dominated by bracken with some birch and very little hawthorn. Ling (*Calluna vulgaris*) was widely distributed in Eastern Plain, especially in the Molinietum (Castell and Jones, 1958). E. W. Groves (1959) stated that, after several fires in 1956 and 1957, none survived in 1958. However, Ling still survives in several places, in small quantities.

Central Plain

This region is divided into two parts by the development of a thick belt of scrub, largely blackthorn, with many hawthorns, some small oaks and roses, running in a N.W.—S.E. direction. In the southern part of this area (area S of Jones), encroaching blackthorn, bramble and hawthorn have reduced the area of bracken, young oaks are growing up amongst and beyond the bracken and it is evident that South-east Wood is spreading towards Central Ditch. This is the area cleared by the Council for Nature's Conservation Corps during 1960-1962 and it was the policy of the Corps to leave young trees, especially oaks, when clearing the scrub. A census of oaks taken within this area of three acres showed, in December 1964, the following: 11 over 12 ft. high: 32, 6-12 ft.; 3, 3-6 ft. and 11, 1-3 ft. This makes an interesting contrast with 11 acres of the S.W. part of Central Plain (Area R), where, in 1959 (Castell, 1960) there were only 14 oaks, 6 over 8 ft. high. Numerous hawthorn, rose and blackthorn seedlings have appeared in the area cleared by the Corps, but, so far, these do not exceed 2 ft. in height.

A small strip of bracken north of the railway line in area S has been replaced by hawthorn, oak and rose, which have spread west of Central Ditch; Rose-bay willow-herb (*Chamaenerion angustifolium*) is locally abundant.

The northern part of area S is now almost totally covered with hawthorn and bracken. Oaks from South-east Wood and from the small wood to the N.W. have spread into the area, with many birches from Eastern Plain.

Bayfield Plain

North of the road bracken has increased slightly. Hawthorn scrub is so thick immediately to the east of the bracken that it is difficult to define the bracken boundary. Elsewhere oaks predominate among the bracken (in January 1965 there were 42 over 12 ft. high) with some willow and birch. Hawthorn has not developed to any great extent, though there are scattered bushes. Rose-bay willow herb is abundant in two places.

Isle of Wight and Western Plains

This area shows the greatest change, with a great increase in scrub and bracken; dense, almost impenetrable, thickets have grown up in several places. It is interesting to note that Western Ditch, Bookham Stream, and in places, footpaths and horserides have been very effective in preventing further encroachment. Oaks are spreading out from Hill House Wood and the gradual natural development of the plains into oakwood can be seen taking place.

Salisbury (1961) has described bracken as "one of the worst weeds of rough pasture". Very few plants will co-exist with bracken and Beven (1964) noted that very few birds are to be found amongst it. At Bookham it is becoming a more serious problem year by year. The scrub is an even more difficult problem. The efforts of the Conservation Corps and the staff of the National Trust are having some effect in parts of the common. Without this work the outlook would be even more hopeless.

REFERENCES

BEVEN, G., 1964. The Feeding Sites of Birds in Grassland with Thick Scrub. *Lond. Nat.*, 43, 86-109.

CASTELL, C. P., 1960. Survey of Bookham Common. Progress Report; A Further Note on the Increase of Scrub Vegetation. *Lond. Nat.*, 39, 64.
CASTELL, C. P. and JONES, A. W., 1958. Notes on the Vegetation of Eastern Plain. *Lond. Nat.*, 37, 58-65.
GROVES, E. W., 1959. A Note on the Heather and Bracken on Eastern Plain, Bookham Common. *Lond. Nat.*, 38, 60-61.
JONES, A. W., 1954. The Flora of Bookham Common. *Lond. Nat.*, 33, 25-47.
SALISBURY, E. J., 1961. *Weeds and Aliens.* Collins, London. (New Naturalist Series), 199.

(In 1968 the National Trust acquired a Bush Hog Rotary Cutter and heavy tractor, and further control of the grassland, bracken and scrub became possible. Some of the effects of this control are described below. G.B.).

Notes on the Vegetation of the Plains after cutting grass and Bracken in 1969 (Ella M. Hillman).

EASTERN PLAIN

In the 1950s the vegetation of this area was typical of wet heathland, the dominant plant being *Molinia caerulea.* The soil here is more sandy and more acid than on the rest of the Common. C. P. Castell and A. W. Jones (*Lond. Nat.*, 1958, **37**, 58-65) have recorded how the Plain was gradually invaded by *Betula pendula* (Birch), *Populus tremula* (Aspen), and *Pteridium aquilinum* (Bracken). In 1968 Bracken covered most of this area, and as it grew to a height of six feet or more the heathland vegetation, being deprived of light, could not survive, and the Molinietum was reduced to a very small area. Very few specimens of *Genista anglica* (Petty Whin), *Ulex minor* (Dwarf Gorse), *Galium saxatile* (Heath Bedstraw), *Potentilla erecta* (Tormentil), and *Lotus corniculatus* (Birdsfoot Trefoil) were to be found only beside the paths where light could penetrate. Ten feet from a path, within the Bracken, all other vegetation was absent except for sparse *Lonicera periclymenum* (Honeysuckle).

In the spring and summer of 1969 Mr. E. F. Youngman, the keeper of the Common, in consultation with the survey team, cut the Bracken down by machine four times during the season, as an experiment in its control. At the end of the summer the new growth of Bracken was only about six to nine inches high in contrast to the unreaped stretches round the edge of the Plain, which reached a height of eight feet. The new Bracken was overtopped by *Molinia* which spread with great rapidity into those areas which had become devoid of almost all plant life except Bracken, and became once more the dominant plant, co-dominant with the new Bracken shoots. As the last cutting took place in August, the *Molinia* stands a good chance of surviving it, its flowering stems being sent up in September. *Hydrocotyle vulgaris* rapidly colonised ground left bare by the cutting of the Bracken in the wetter areas on the South-western part of the Plain. Much of the invading Birch and Aspen has also been cut down in an attempt to preserve the interesting Heath flora.

BAYFIELD PLAIN

The keeper has also cleared and widened most of the paths on all the plains and scrub areas, and on Central and Bayfield Plains he has cut down some of the coarse tufts of *Deschampsia caespitosa*, which dominates the ground vegetation on the Plains until invaded by Hawthorn (*Crataegus monogyna*). The result of this cutting was spectacular. One area became a Juncetum dominated mainly by *Juncus conglomeratus* (but other species of *Juncus* were also present), and this happened as a result of cuttings in October 1968 and May 1969. The Juncetum showed a profusion of flowering stems in July 1969. It was then reaped in late July, and on August 3 one could find only a few flowers or fruits among the tufts of *Juncus*. By September 14, the *Juncus* had produced many more flowers, some of which were of *Juncus effusus*, which is a later flowering species, but overlapping in time with *J. conglomeratus*. The *Deschampsia*, on the other hand, though its tufts persisted, sent up no more flowering stems. There was thus a marked difference in appearance between the cut areas of *Deschampsia* and the uncut areas with their conspicuous tall dried flowering stems.

Central Plain

Here the story of *Deschampsia* is the same, but its control favoured the spread of *Angelica sylvestris* so that this handsome Umbellifer became abundant and a conspicuous feature of the scene. This plant flowers from July to September, and it would be worthwhile to study all these three Plains in 1970 to see whether there is any indication that this year's (1969) cuttings favour the spread of later-flowering species by, perhaps, mowing down others before these have time to seed. There is, of course, vegetative reproduction to be reckoned with.

It would seem that management of the Common with the controlled use of the rotary cutter, of which the prime purpose is to halt the progress towards a "jungle", and so to improve the amenities for the general public, will also stave off uniformity in the vegetation and create small regions where plants other than *Deschampsia* and *Pteridium* can flourish.

Coelenterata—Hydroids (A. E. Le Gros)

Further to the note (*Lond. Nat.*, 1969. **48,** 128) recording three species of *Hydra* for the Common, a fourth species, *Hydra vulgaris* Pallas was found among large numbers of "brown" *Hydra* present in Sheepbell pond on October 18, 1969.

Turbellaria—Freshwater Triclads (A. E. Le Gros)

To the two species of Triclads previously mentioned (*Lond. Nat.*, 1968. **47,** 90) may be added (1) *Polycelis nigra* (OFM), abundant in Central ditch round the lower part of plants growing in the mud, (2) *Polycelis tenuis* Ijima found in I.O.W. pond.

Nematoda

(determined by J. W. Coles)

Family MONHYSTERIDAE

Monhystera paludicola de Man. Amongst algae, Isle of Wight pond, June 9, 1968.

Family CHROMADORIDAE

Chromadorita leuckarti de Man. In surface mud and debris of stream leading to Isle of Wight pond, adjacent to road, March 9, 1969.

NOTE: This species was listed incorrectly as *Neochromadora izhorica* (Filipjev) in the Bookham Common Progress Report for 1968 (*Lond. Nat.*, 1969. **48,** 128-129) and both records given (Isle of Wight pond, May 1958 and the one from Scotland, March, 1960) refer to *Chromadorita leuckarti*.

ROTIFERA

(determined by J. W. Coles)

Synchaeta pectinata Ehrenberg. Very abundant in Isle of Wight pond, August 11, 1968.

HIRUDINEA—LEECHES (G. Beven).

A. E. Le Gros has contributed the following records:—

Theromyzon tessulatum (OFM) found in 1964 I.O.W. pond. A parasite of waterfowl.

Hemiclepsis marginata (OFM) found in 1967 I.O.W. pond. A fish parasite which also probably attacks tadpoles.

Glossiphonia complanata (L) found in 1967 Lower Eastern pond. Preys on water snails.

Helobdella stagnalis (L) Frequent I.O.W. and L.E. ponds 1968-9. Predator on small invertebrates. This species was also present in I.O.W. pond July 29, 1967 (J. W. Coles, *Lond. Nat.*, 1968. **47,** 90) and was also collected at a Quekett Club meeting on August 9, 1969 from Lower Eastern pond (determined by E. G. Easton).

Three other species have been previously recorded from the Common:—

Haemopsis sanguisuga (L) Horse Leech, collected by C. J. F. Bensley from I.O.W. pond on April 19, 1946.

Hirudo medicinalis (L) Medicinal Leech. April 2, 1938 from Bookham pond (? I.O.W. pond) (*Proc. S. Lond. Ent. Nat. Hist. Soc.* for 1938-39, 38-9).

Erpobdella testacea (Savigny) July 29, 1967 I.O.W. pond (J. W. Coles, *Lond. Nat.*, 1968. **47,** 90).

CRUSTACEA

(determined by W. A. Smith)

BRANCHIURA

Argulus foliaceus (L) Found free in Isle of Wight pond, August 9, 1969 (collected by Miss Mary E. H. Stevens).

ARACHNIDA (A. E. Le Gros)

The British Arachnological Society during a field week in Surrey in 1968, visited Bookham Common on August 24. A report by our member D. R. Nellist (*Bull. Brit. Arach. Soc.*, 1969, **1,** 55-60) notes that the B.A.S. found 67 species of spiders and 5 species of Harvestmen. Of the spiders 11 species were recorded from the Common for the first time, bringing the known total to 182. A revised account of the Bookham Arachnids is under preparation.

INSECTA—PSOCOPTERA (A. E. Le Gros)

C. N. Smithers, a specialist on the *Psocoptera* or Book Lice, visited the Common on June 15, 1968 and collected four species *Caecilius flavidus* (Steph), *Graplosocus cruciatus* (L), *Ectopsocus briggsi* McLach and *Mesopsocus immunis* (Steph) (*Ent mon Mag.*, 1969, **105,** 54). As far as I can trace these are the first to be recorded from Bookham.

Over the last four years I have met with *Loensia fasciata* (Fab), *Psococerastis gibbosa* (Sulz), *Elipsocus hyalinua* (Steph) and *Ectopsocus briggsi* McLach when beating oak in June and July. There is no recent British monograph on the group but I have found A. Badonnel's *Psocopteres* (*Faune de France*, No. **42**) describes nearly all the species likely to be met with in our woods. *E. briggsi* hibernates as an adult and is frequently met with in winter under bark and in old galls of *Biorrhiza pallida* and *Andricus kollari*. It is an easy species to rear in the laboratory.

Insecta—Lepideroptera (G. Beven)

Purple Emperor Butterfly *Apatura iris*. A male was watched feeding on horse's dung on a footpath by Hill House Wood (466) on July 5, 1969 (G.B.). A male was again seen momentarily on the ground near Central Ditch (815) on July 13, 1969 (G.B.) and a male was seen on coconut matting on the ground in her garden (449) by Mrs D. Macer-Wright in the first week of August. Previous records of Purple Emperors at Bookham are (1) ♀ August 11, 1947 (C. G. M. de Worms, *Lond. Nat.*, 1950. **29,** 67) and (2) Pair in cop, July 7, 1952 observed by R. M. Craske (C. G. M. de Worms, *Lond. Nat.*, 1959. **38,** 36). White Admiral Butterflies *Limenitis camilla* were seen in fair numbers during July and early August.

HYMENOPTERA—Wasps (P. W. E. Currie)

RECORDS OF WASPS

Embolema ruddii Westwood.	April 8, 1951, ♀ E. Hollow, shaken from grass tuft.
Bethylus cephalotes (Forster).	♀ April 16, 1950, MR 582, swept from grass.
Tiphia femorata Fabr.	♂ 2♀♀ August 5, 1950, at flowers of *Torilis japonica* (Houtt).
T. minuta van der Linden.	♂♂ June 4, 1949, August 5, 1950, (2), August 13, 1950 at flowers of *T. japonica* and *Angelica sylvestris* (L).
Myrmosa atra Panz.	♂♂ June 26, 1949, August 5, 1950, 4 ♀♀ August 27, 1950, at flowers of *T. japonica* etc.
Priocnemis perturbator (M. Harris).	♀♀ April 24 and June 6, 1949.
Deuteragenia hircana (Fabr.).	♀ June 1949, 2♂♂ 2♀♀ June 4, 1949 MR 5132 at dead oak tree.
D. intermedia (Dahlbom).	♀ June 5, 1949 MR 8483 with spider prey at hole in old poplar stump.
Odynerus laevipes (Shuckard).	♂♀ bred 25, June 28, 1949, from bramble stems. 2 ♂♂ 5, June 6, 1949. 2 ♂♂ bred 4, June 6, 1950, from bramble stems.
Ancistrocerus callosus (C. G. Thomson).	2♀♀ May 1 and June 12, 1949, 3♂♂ 3♀♀ August 14, 1949, ♀ August 5, 1950, mostly at holes in dead wood.
A. trimarginatus (Zett.	♀ June 26, 1949.
Symmorphus sinuatissimus Richards.	♀ June 12, 1949, ♂♀ June 11, 1940.
Vespa crabro (L).	Dormant ♀ under bark of dead ash tree April 8, 1950, ☿☿ not uncommon at flux of oak trees in the northern parts of the woods.
Astata boops (Schr.).	♀ August 27, 1950, MR 426.
Trypoxylon figulus (L).	♀ June 5, 1949, MR 8483, poplar stump.
T. clavicerum (Lep.).	♂ June 11, 1950.
Pemphredon lugubris (Fabr.).	♀ May 22, 1949, ♂ August 13, 1950.
Cemonus shuckardi (Morawitz).	♂♂ May 22 and June 12, 1949, on currant leaves, Central Plain.
C. wesmaeli (Morawitz).	♂ June 11, 1950 Central Plain on black currant *Ribes nigrum* (L).
Passaloecus insignis (van der Linden).	♂ June 4, 1949, ♀ August 5, 1950.
P. gracilis (Curtis).	♂ June 26, 1949, ♀♀ June 11 and August 13, 1950, in clearings in the woods.
Mimesa shuckardi (Wesmael).	♀ June 26, 1949, MR 426, entering hole.
Coelocrabro leucostomoides (R chards).	♀ October 10, 1948, ♀ June 11, 1950, on dead wood.
C. cetratus (Shuckard).	2 ♂♂♀ May 29, 1949, MR 628 at dead oak. ♀ June 11, 1950.
C. ambiguus (Dahlbom).	♀ August 14, 1949.
C. leucostomus (L).	2 ♀♀ June 6, 1949, ♀ June 26, 1949, in woodland.
Ablepharipus podagricus (van der Linden).	♂ August 5, 1950, MR 869, parsnip flowers *Pastinaca Sativa* (L). 2 ♀♀ June 11, 1950, August 13, 1950.
Blepharipus confusus (Schulz).	♀ August 13, 1950, MR 297, at flux of oak.
Clytochrysus planifrons (C. G. Thomson).	♀ August 5, 1950, at Angelica flowers, Bayfield Plain.
C. cavifrons (C. G. Thomson).	♀ August 28 1949, 5 ♂♂ from pupae in dead birch, Eastern Plain, em. June 11, 1950 also 1 *Eustalomyia histrio* Zett. (Dipt., Muscidae), det. L. Parmenter.
C. chrysostomus (Lep. & Br.).	♂ June 5, 1949, ♀ July 24 1949, ♂ August 28, 1949

Solenius rubicola (Dufour & Perris).	♂♂ June 5, 1949, June 11, 1950, August 5, 1950, ♀ June 11, 1950.
S. continuus (Fabr.).	♂♂ June 4 and 5, 1949, ♀ June 12, 1949, 3 ♂♂, 2 ♀♀ August 28, 1949.
Rhopalum clavipes (L).	♀ June 12, 1949.
Lindenius albilabris (Fabr.).	♀ June 26, 1949, 3 ♂♂, 5 ♀♀ June 11, 1950, MR 426, at *Andrena* colony. ♀ August 5, 1950.
L. panzeri (van der L.).	2 ♀♀ August 14, 1949, High Point, from several entering a single hole in the ground.
Nysson spinosus (Forster).	♂♂♀ June 5, 1949, ♀ June 12, 1949, 2 ♂♂ June 11, 1950.
N. trimaculatus (Rossi).	♂ May 22, 1949.
Gorytes mystaceus (L).	♀♀ June 12 and 26, 1949, June 11, 1950, ♂ May 14, 1950.
Hoplisus quadrifasciatus (Fabr.).	♀ August 5, 1950, MR 815, are flowers of *T. japonica*.
Cerceris rybyensis (L).	2 ♀♀ August 14, 1949, ♀ August 5, 1950, at holes in paths at High Point and *Andrena* colony at MR 426.

Note: the nomenclature used in this list follows that in Kloet and Hincks, *Checklist of British Insects* (1945). MR = Map Reference.

Insect Visitors to Flowers (A. E. Le Gros)

On four visits to Bookham in August-September 1969 a note was made of the insects visiting the white flowers of the larger bindweed *Calystegia sepium* (L) in a colony on the Central Plain. Only the insects that worked their way down into the heart of the flowers to reach the glandular hairs were recorded. The few casuals that used the flowers as resting or sunning places were ignored. Growing about the bindweed were many plants of the sowthistle *Sonchus arvensis* (L) whose yellow flowers attracted not only more species than the bindweed, but far greater numbers of individuals, and a note was made of the insect visitors seen on August 21, and September 24.

The bindweed visitors were:—

Apidae. The honeybee *Apis mellifica* (L) and the bumble bees *Bombus agrorum* Fab, *H. hortorum* (L) and *B. terrestris* (L). Most of these were seen on August 13, a hot sunny day, only the *B. agrorum* being seen later. Diptera. The Syrphid flies *Helophilus pendulus* (L), *Rhingia campestris* Mg, *Syrphus balteatus* (DeG), *S. luniger* Mg (one specimen) and *S. ribesii* (L). Of these *balteatus* and *ribesii* were abundant and formed 90% of the flies. 1969 was a *balteatus* year the resident population in Britain being augmented by large migrations from the continent and most of them seen at Bookham were males. Hemiptera. *Anthocoris nemorum* (L). Two searching for Thrips? Lepidoptera. *Simaethis fabriciana* (L). This micromoth, identified by R. W. J. Uffen, was a frequent visitor each day.

Parmenter (*Lond. Nat.*, 1950, **29,** 105 and 1954, **33,** 93) reported only three flies visiting *Calystegia*, *Rhingia macrocephala* (Harris) (= *R. campestris* Mg) at Bookham, and *Platychirus peltatus* Mg and *Syrphus balteatus* DeG at Cripplegate. Uffen (*Lond. Nat.*, 1962, **41,** 69) noted the moth at Chiswick as a common visitor to bindweed flowers in daylight. I also made a check of bindweed flowers in other localities although some of the observations were brief—to see if the limited number of regular visitors (i.e. social bees, a small moth and perhaps only four or five Syrphid flies) would be found elsewhere and I think this was so. The species seen were:—

August 23, By the River Colne, Cowley, Middlesex. *Syrphus balteatus* (DeG) abundant, *S. ribesii* (L) frequent.

September 9, Hayes Common, Kent. *Syrphus ribesii* (L) frequent, the ladybird beetle *Propylea 14-punctata* (L) (one) and *Apis mellifica* (L) (many).

September 10, Cowley, Middlesex. *Helophilus pendulus* (L) in some numbers.

September 12, Keston Common, Kent (at pink flowers close to s.sp *pulchra*) *Syrphus ribesii* (L) frequent, *Platychirus peltatus* Mg (one) and *Simaethis fabriciana* (L) (Two).

September 20, Allotments, Hither Green Railway Station, S.E. London (on white flowers of s.sp *sylvatica*). *Syrphus ribesii* (L) abundant, syrphid *Scaeva pyrastri* (L) (several), *Apis mellifica* (L) frequent and *Bombus muscorum* (L) (one). All of these were seen also at nearby ragwort flowers.

The yellow flowers of the sowthistle have their nectar more readily accessible than those of the bindweed, and also allow the insects to see approaching enemies which the bindweed flowers do not. Consequently many feeding insects flew off, avoiding my net as I approached the flowers. Parmenter (*Lond. Nat.*, 1950, **29,** 104) recorded the Trypetid fly *Ensina sonchi* (L) and five Syrphid flies *Eristalis arbustorum* (L), *E. tenax* (L), *Scaeva pyrastri* (L), *Syrphus balteatus* (DeG) and *S. vitripennis* Mg visiting the flowers of the Corn Sowthistle at Bookham. Spending a total of nearly four hours over the two days I was able to record the following species:—

Apidae. *Apis mellifica* (L) (abundant), *Bombus agrorum* Fab (frequent and a solitary bee *Halictus* sp (one).

Ichneumonidae. *Dicaelotus* sp? (one).

Lepidoptera. *Aglais urticae* (L) The Small Tortoiseshell (one), *Simaethis fabriciana* (L) frequent.

Diptera. Muscidae. *Orthellia cornicina* (F) (abundant) and *Phaonia erratica* Fall abundant. *Hydrotaea* sp (one). Mycetophilidae. *Sciara* sp (one).

Syrphidae. *Eristalis tenax* (L) (abundant), *E. arbustorum* (L) (one), *E. pertinax* Scop (one), *Helophilus pendulus* (L) frequent, *H. hybridus* Loew (two), *Rhingia campestris* Mg several, *Platychirus peltatus* Mg (one), *Scaeva pyrastri* (L) (one), *Syrphus balteatus* (DeG) abundant, *S. ribesii* (L) abundant, *Syritta pepens* (L) (one).

One Piophilid and a Tachinid fly I was unable to name. On September 24, two very common species, the drone fly *Eristalis tenax* (L) and the green muscid *Orthellia cornicina* F, both of which ignored the bindweed, were seen to visit all the other flowers in its vicinity, yellow buttercups and composites, white umbellifers and mauve Michaelmas Daisies.

BIRDS (G. Beven)

Oakwood (*Eastern Wood*)

The breeding season census was repeated in this 40 acre sample of dense interior oakwood. The number of territories of singing males of selected species over the last seven years was as follows:—

	1963	1964	1965	1966	1967	1968	1969
Starling	5	5·6	10	6	8	12	7
Nuthatch	2	5	5	5	7	5	3
Blue Tit	19	19	22	17	16	20	19
Marsh Tit	3	1	1	3	3	3	3
Chiffchaff	2	5	7	6	6	3	3
Garden Warbler	2	2	4	1	1	1	1
Mistle Thrush	1·5	2	3	2	1	1	2
Blackbird	8	10	12	11	12	11	13
Dunnock	4	5	5	4	8	6	6
Chaffinch	5·5	7	8	7	6	4	4
Great Tit	12	17	17	12	16	19	14
Coal Tit	2	5	4	3	8	6	7
Longtailed Tit	0	0	1	2	2	1	1
Willow Warbler	2·5	1·5	4	4	2	6	2
Blackcap	5	3	4	7	6	3	6
Song Thrush	4	7	7	8	10	7	7
Robin	21·5	32	37	37	42	43	44
Wren	1	5·5	11	17	25	26	24

Scrub and Grassland

The spring census of the number of territories of singing males was again made on 96 acres of scrub and grassland in 1969. The number of territories of selected species over the last six years was as follows:—

	1964	1965	1966	1967	1968	1969
Pheasant	2	2	3	3	2	7
Wood Pigeon	1	2	4	1	1	6
Turtle Dove	5	4	3	5	3	7
Green Woodpecker	0	1	4	4	4	1
Wren	2	3	9	10	15	14
Song Thrush	8	8	7	10	9	9
Blackbird	15	8	13	17	15	15
Robin	23	23	15	21	23	23
Whitethroat	12	17	17	22	16	11
Willow Warbler	20	14	19	27	21	26
Dunnock	11	15	13	18	12	12
Linnet	1	4	4	4	1	2
Chaffinch	18	13	13	14	9	12
Yellow Hammer	9	7	9	7	8	7
Reed Bunting	3	2	5	6	5	3

Thus over the whole of this area the pheasants have increased and the number of Wrens is still high. There was a 30% reduction in the Whitethroat population in this habitat. Elsewhere in England there seems to have been a 70% reduction in Whitethroats in farmland and woodland, so that scrubland is presumably an optimal habitat. There was no corresponding reduction in Willow Warblers. During 1969 about half an acre (of these 96 acres) was partially cleared of scrub by the National Trust, while the long grass was cut on about fifteen acres of previously cleared scrubland.

Unfortunately the bird census of Eastern Plain was not repeated in 1969, owing to lack of observers. However, a special lookout was kept for the return of the Tree Pipit. It is thus of interest to report that a male was singing on May 28, 1969, June 1, 1969 and July 13, 1969 at ref. 823/597 in the same area as last year. As already mentioned, the bracken on this plain was cut four times during the summer, thus preventing it from becoming dominant. The situation next Spring will be watched with interest.

Other Notes on the Birds

A pair of Little Grebe spent the summer on the Isle of Wight pond and another was present on Lower Eastern pond. Several family parties of Mallard were seen. The Mandarin Duck *Aix galericulata* has increased along the Mole valley in recent years, and in 1968 several were noted just north of Bookham Common. However during January, February and March 1969 birds were recorded for the first time on the Common, on Lower Eastern and Isle of Wight ponds, while a flock of 13 was seen flying over South-east Wood on March 9, 1969. Some birds remained until the end of April, but there was no evidence of nesting. The duck were again seen on the Common in January 1970. One pair of Kestrels was present, and Sparrowhawks were seen in January, March, April, May and September. A pair of Coot raised three young on the Isle of Wight pond. At least one Woodcock was roding in May.

Seven Tawny Owls were heard hooting. Five of these were in the 250 acres of woodland in which in 1965 there were 4, 1966 4, 1967 3-4, and 1968 5. Pellets of a Tawny Owl found in Eastern Wood (6281) in March-April 1969 contained 2 Bank Voles, 1 Wood Mouse, 14 House Mice, and 2 Brown Rats, suggesting that this bird was hunting near the houses at the edge of the woodland. The number of pairs of Long-tailed Tits in the Spring in an area of about 120 acres of grassland and scrub during 1969 was 6, including 3 nests. In 1962 the number of pairs was 6, in 1963 nil, 1964 3, 1965 4, 1966 4, 1967 6, and 1968 6. In 1969 another pair was seen building a nest 60 or more feet up in an oak in Central Wood (548). There were 4 Nightingales in song during the Spring, two juveniles being noted on August 3, 1969. (Ella M. Hillman). Six Grasshopper Warblers were heard singing. A Hawfinch was in South-East Wood on April 18, 1969, (Robin Griffiths) and several were on Western Plain in December (Clare Harding). In 96 acres of scrub and grass there were 6 territories of displaying male Redpolls during 1969. Previously up to 1962 there were none, 1963 1, 1964 2, 1965 3, 1966 5, 1967 4, and 1968 4. (The previously published estimates for 1965 and 1966 are now considered to be too low).

MAMMALS The Rabbit Survey (Michael Towns)

It is hoped that members will record all their observations on rabbits in the notebook now being kept in the Research Hut.

The aims of the rabbit survey have been divided on a long-term and short-term basis. The long-term project has involved the mapping of the zonation of the vegetation, in an area grazed by the rabbits, with a view to recording the changes effected by their activities. The short-term projects have been concerned with (1) locating the preferred habitats as regards cover, access to feeding grounds, and vegetational formations. (2) Undertaking a "sweep" of the common to ascertain the frequency of the animal on the common.

Examination of twenty-two rabbit burrows has yielded the unexpected result that, apart from one which had galleries leading to other exits, all the burrows have either ended blindly or have travelled simply in a straight line to another exit. None of the burrows examined was excavated by the rabbits below a depth of two feet from the surface, and the simple burrows were rarely longer than four feet.

From these first tentative findings it would seem that, at least in the areas surveyed so far, the rabbit population is primarily surface living and the simple holes act merely as a form of temporary shelter.

MAMMAL RECORDING

Unfortunately, it has not been possible to prepare a Mammal Report for this year's issue of the *London Naturalist*. It is intended, however, to publish in the future a series of maps, each showing the distribution of a species in the Society's area. In order that these maps should be as up to date and complete as possible, members are urgently requested to send any records to the Mammal Recorder, Ian Beames, 69 Gadeson Road, West Ewell, Epsom, Surrey.

BADGER CORPSES

John Landells has now taken over Professor R. J. Harrison's work in collecting badger corpses (vide *London Naturalist* **48,** 72). Mr. Landells will try to collect specimens in reasonable condition, from *South* London only, but cannot guarantee to do so; he can be contacted c/o London Hospital Medical College, Turner Street, E.1 (01-946 9408).

THE SOCIETY'S COLLECTIONS

Members are asked to note that the Society's collections of Mollusca, mammal skins, skulls and skeletons is now in the care of the new Curator, David Warren, 76 Hazelwood Road, Bush Hill Park, Enfield, Middlesex any request to view the collections in the pursuit of research projects should be made to him in writing.

Flowers and Figures

Some Quantitative Aspects of the Flora of Bookham Common

By E. M. Hillman

> "To me the meanest flower that blows can give
> Thoughts that do often lie too deep for tears"
> Wordsworth.

"The Flora of Bookham Common" was published by A. W. Jones (1954), who carried out the survey with the collaboration of four expert botanists. This account is an attempt to analyse their results with special reference to the number and variety of species occurring in different areas of the common. The relative abundance of species was assessed in the original paper, and, as that is irrelevant here, no mention will be made of that aspect of the work.

The common was divided into 20 areas "of similar size", lettered A to T. As the boundaries had perforce to be paths and streams, exact equality of area would have been impossible to achieve. One cannot divide a public common into neat rectangular strips as at an experimental research station. Nevertheless good agreement in size was reached, except in the case of area L, which is considerably smaller than average and also contains fewest species. To remove possible bias due to its small size it has been added to the adjacent area K to form one area K-L comparable in size with the rest. In the following discussion there are therefore 19 areas each of about 20 acres or approximately 80,000 sq. metres.

A few species were recorded as being in one area *or* the adjacent area, probably because the plants were on the boundaries. In counting, such records have been allotted ½ to each area. A few species, too, were recorded as aggregates, so that the number of species may be a little higher than appears here, but with the large numbers involved these do not greatly affect the results. In all, 3,180 records were made of 476 species of vascular plants.

In the map accompanying the original paper, eight main types of vegetation are depicted, which are here numbered for reference in Table I which follows.

1. Grassland dominated by *Deschampsia caespitosa*
2. Grassland dominated by *Molinia caerulea*
3. Bracken areas (*Pteridium aquilinum*)
4. Marshy areas
5. Other open areas
6. Scrub, often *Crataegus monogyna*
7. Woods: dominant tree *Quercus robur*
8. Ponds.

The botanical names used are those which were adopted for the original paper (for easy reference) and are from the first edition of Clapham, Tutin and Warburg's "Flora of the British Isles". In the following Table I, brackets indicate that the areas covered by those types of vegetation are small compared with the remainder.

TABLE I
(see accompanying map, Figure I)

Area	Vegetation Types in the area	Number of species (ignoring ½ in totals)
R	1, (3), 5, (6), (7)	237
N	1, 4, 5, (6), 7, 8	230
Q	1, 2, 3, 5, 6, 8	218
D	1, 3, 5, 6, 7	207
M	1, 2, 3, 5, (6), 7, 8	206
O	1, 3, 5, 6	196
S	1, 2, 3, 5, (6), 7	196
P	1, 3, 6	187
J	7	177
T	1, 2, 3, 6, 7	176
E	1, 5, 6, 7	175
A	5, 7, (8)	160
I	1, 5, (6), 7	130
C	5, 7, (8)	129
K-L	7	118
B	7	116
G	(1), (6), 7	95
H	(5), 7	84
F	(1), 7	79
		Total: 3,116 (less than 3,180 due to amalgamation of areas K and L)

The areas will now be grouped according to their adjacent geographical positions and vegetation types. The 19 areas fall very conveniently into six groups of three, with area N omitted as it forms a class by itself consisting of the larger aquatic habitats with their fringes of marsh and woodland.

TABLE II

1 Areas		2 Description	3 Mean no. of species recorded in each a	4 Greatest deviation from mean as % of mean b	5 No. of species in combined area c	6 Column (5) as multiple of mean, Column (3) d=c/a
Group I	FGH	Woods surrounded by woods	86	15	126	1·47
	ABC	Woods on northern boundary adjoining arable land	135	18	212	1·57
	IJK-L	Woods, eastern and south-eastern parts, adjoining gardens or aquatic habitats	142	25	243	1·70
Group II	MST	Mixed. Southern end of scrub, plains and fringe of wood	193	9	301	1·56
	DEO	Similar, north-western end	193	9	301	1·56
	PQR	Mixed. Mainly grassland and scrub, south-western side	214	13	319	1·50
					Mean (excluding IJK-L)	1·53 (S.D. = 0·04)

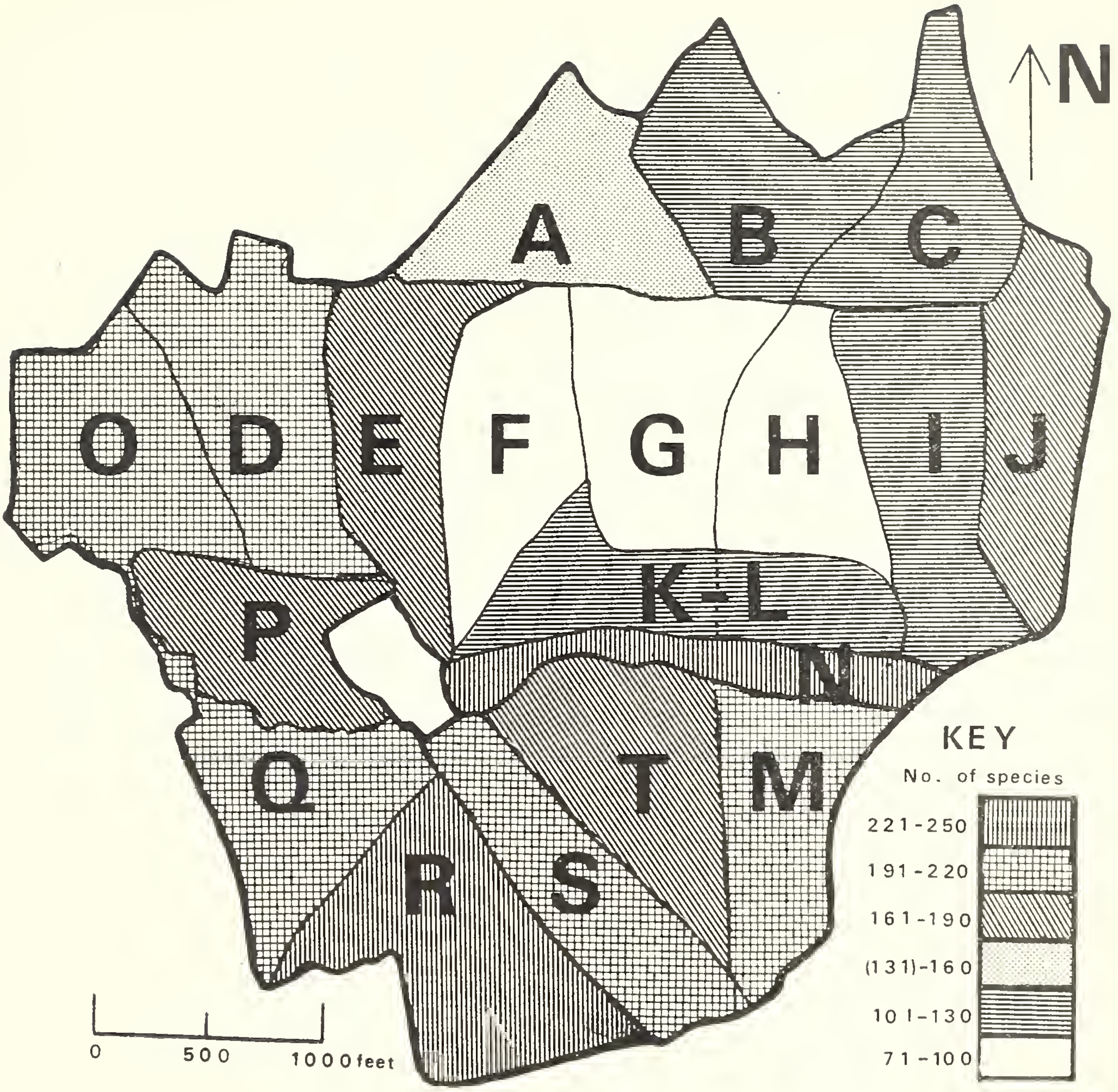


FIG. 1. Vegetation map of Bookham Common to show the areas in relation to the number of species of vascular plants found in each.

The difference between the mean number of species per area in the first group, 121, and that of the second group, 200, is marked, and statistical tests (including Student's t-test) show that it is highly significant (probability less than 0·1 of 1% that it is due to chance). Moreover, the mean for the inner woodland area is significantly different ($P < 5\%$) from that of the other woodland areas.

The next part of the paper investigates the question as to how the total number of species in a combined area is related to the mean number of species in the three component parts. For example, in combining the three inner woodland areas F, G, H, with 79 species in F, 95 in G, 84 in H (mean = 86), it is found, by counting, that FGH contain 126 species, which is 1·47 times the mean. This has been done for all the groups, and the results are given in Table II. (The identical results for DEO and MST are a coincidence, not a misprint!)

The results suggest that where three neighbouring areas are alike in the number of species they contain to the extent that the greatest deviation is not more than one-fifth of the mean number, then the number to be found in the combined area is about 1½ (1·53) times the mean, which is connected with the fact that the three component areas will have about one-third (29%–38%) of their species in common. The result for the combined area IJK-L differs significantly ($P<1\%$) from the mean of the rest, and it will be noted that this is the least homogeneous set, where the divergence from the mean is greatest. Area J has a comparatively high number of species, and it contains the second highest number of Bookham "rarities", i.e. those species which occur in one area only. Many of these prove to be garden weeds, and as area J is flanked by gardens it is very probable that it was being diversified from a neglected one at the time. (A list of species found only in area J is given as an appendix.)

Since area IJK-L does not satisfy the requirement that the number of species in each area should not differ too widely from their mean (by not more than 20%) it will be omitted from the remaining discussion, which deals with more uniform combinations of habitats. The remarkable consistency of the results is a tribute to the thoroughness with which the original investigation was carried out, and encouraged further inquiry into the effect of combining the areas of each group in pairs. In this case the number in the combined area was found on average to be 1·33 (S.D. 0·04) times the mean. Since the proportional increments in the number of species found by doubling and trebling an area are as 0·33:0·53, which is approximately equal to log 2:log 3, Figure II is drawn showing the ratio $\frac{S_n}{S_1}$ plotted against log n, where

S_1 is the (mean) number of species in the original sample
S_n is the number of species in a combination of n such areas.

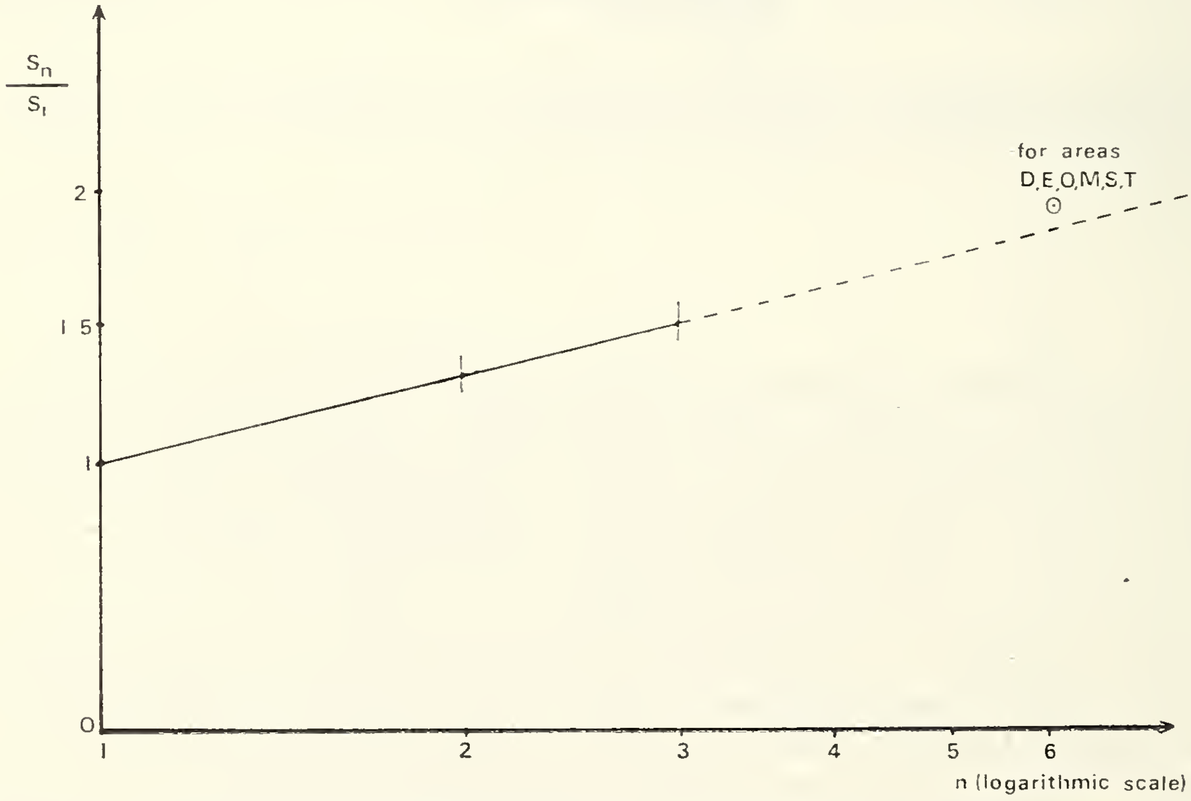


FIG. 2. Graph to show the relation $^{S_n}/_{S_1}$ with log n, S_1 being the mean number of species found in one area and S_n the number found in n similar areas.

This is found to be linear for values of n from 1 to 3 for the five combinations examined, and the equation connecting S_n and n is $\frac{S_n}{S_1} = 1 + k \log n$ so that $k = \frac{0\cdot33}{\log 2} = \frac{0\cdot53}{\log 3} = 0\cdot48$ with logarithms to the base e, for area samples of 20 acres. Where the equation is written $S_n - S_1 = kS_1 \log n$, kS_1 is seen to be the same as the Index of Diversity (α) (Williams, 1944) which is stated to be independent of sample size. α seems to be the product of two factors,

S_1 (the number of species in the sample area) which depends on the diversity of species in the habitat, but also increases with the size of the sample, and

the factor k, which decreases as the size of the initial sample increases (in fact, starting with a sample n times as large as that giving a value of k equal to k_1, the value $k_n = \frac{k_1}{1 + k_1 \log n}$ on theoretical grounds), but which seems to be independent of the type or diversity of the area (see column 6 of Table II on which the value of k depends) provided that the samples to be combined themselves satisfy certain conditions of uniformity one with another (see appendix (3)).

Using the value 0·48 for k, the Indices of Diversity for the homogeneous groups of areas are:

		α
Inner Woodland FGH	$0\cdot48 \times 86$	41
Outer Woodland ABC	$0\cdot48 \times 135$	65
Scrub DEO, MST	$0\cdot48 \times 193$	93
Grassland and Scrub PQR	$0\cdot48 \times 214$	103

It is stated that there has been discussion as to whether the graph of number of species plotted against log (area) is linear or sigmoid (Greig-Smith, 1964). For one case which I have examined the line curves upwards for n–4, but this is accounted for by the fact that for the most part the similar areas fall into groups of three and the addition of a fourth includes a new vegetation type. C. B. Williams says that the linear law holds provided that samples are taken from the same population in the same ecological situation, and the number of species will increase more rapidly if we extend into a different population. The required "uniformity" therefore cannot in general be found to extend over more than about 60 acres at Bookham, and we must remind ourselves that in three 20-acre areas "uniformity" requires only one-third of the species to be common to them all.

In the case of the six areas DEO, MST, however, we have a set which, although they are not actually adjoining, are separated only by a small strip of area N, and form a belt of scrub running across the common from North-west to South, and for these six areas $\frac{S_6}{S_1}$ is shown. Here the graph appears to be linear for values of n up to 6. It is hoped to continue investigations when a set of punched cards forms part of the Bookham Research equipment, at present all counting has been done the primitive and laborious way.

Figure III shows the number of species which occur in only one area, in exactly two areas, exactly three areas, and so on up to 19 areas.

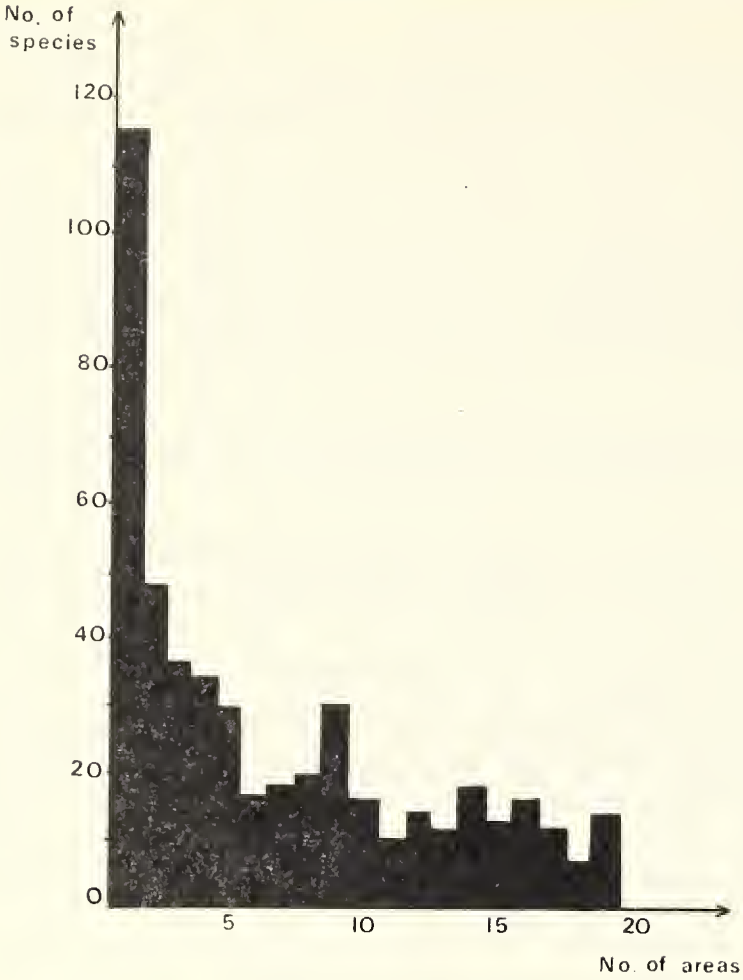


FIG. 3(a). Relation between the number of species and the number of areas in which they are found.

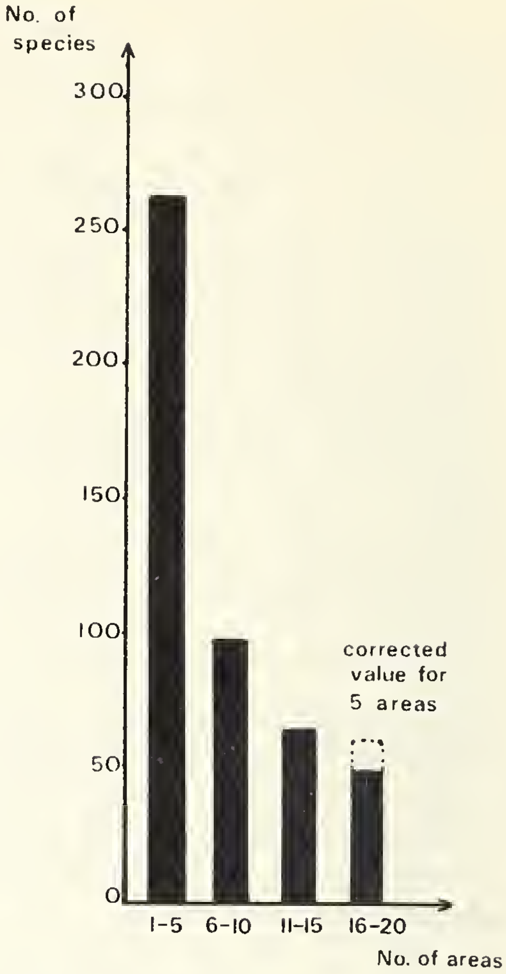


FIG. 3(b). The data of fig. 3(a) in groups of 5 areas.

Of the 115 species which are found in only one area, 19 occur in Q, 14 in R, 14 in J, and 10 in N, but only one of them is found in area G and none in F or H (the three inner woodland areas).

The original paper listed the most common species for each habitat. Below is a list of the most widely distributed species on the common, those which were found in over 75% of the sample areas.

All 19 areas

Cirsium palustre
Crataegus monogyna
Deschampsia caespitosa
Holcus lanatus
Juncus effusus
Lonicera periclymenum
Potentilla erecta
Pteridium aquilinum
Quercus robur
Ranunculus flammula
R. repens
Rosa spp.
Rubus spp.
Salix atrocinerea
Stellaria holostea

18 areas

Dactylis glomerata
Hedera helix
Prunella vulgaris
Prunus spinosa
Rumex acetosa
Tamus communis
Veronica chamaedrys

17 areas

Anthoxanthum odoratum
Betula verrucosa
Brachypodium sylvaticum
Chamaenerion augustifolium
Galium aparine
Glechoma hederacea
Poa annua
Potentilla anserina
Potentilla sterilis
Rumex sanguineus var. *viridis*
Sambucus nigra
Taraxacum officinale

16 areas

Agrostis canina
Ajuga reptans
Cerastium vulgatum
Corylus avellana
Fragaria vesca
Fraxinus excelsior
Geranium robertianum
Geum urbanum
Ilex aquifolium
Juncus bufonius
Plantago major
Potentilla reptans
Ranunculus ficaria
Solanum dulcamara
Stachys sylvatica
Stellaria graminea

15 areas

Alisma plantago-aquatica
Arrhenatherum elatius
Carex hirta
Cornus sanguinea
Dryopteris felix-mas
Galium hercynicum
Heracleum sphondyllium
Juncus conglomeratus
Lotus uliginosus
Ruscus aculeatus
Trifolium repens
Urtica dioica
Viola riviniana

APPENDIX

(1) *Species found only in area J.* Those marked (G) suggest that the area was diversified by escapes or weeds from adjacent gardens.

(G) *Calystegia sylvestris*
Epipactis sessiliflora
(G) *Fragaria* cf. *x ananassa*
Fumaria officinalis
Hordeum spp. (Barley)
Hypericum androsaemum
(G) *Lactuca sativa*
(G) *Ligustrum ovalifolium*
(G) *Melissa officinalis*
(G) *Pentaglottis sempervirens*
(G) *Oxalis europaea* (Jord.)
(G) *Polygonum cuspidatum*
(G) *Primula* spp.
(G) *Tropaeolum majus* (Nasturtium)

(2) *Species found in A but not in B or C.* A, B, C, are the northern most woodland areas bounded on the north by farmland. At the time of the survey A and C each contained a small open area and a small pond. It is to be expected that A and C will each contain rather more species than B (A 160, C 129, B 116) but it is not easy to explain why the number of species found in A alone of these three areas should be twice as many as those in C alone.

Achillea ptarmica
Adoxa moschatellina
Agrimonia odorata
Alopecurus geniculatus
Arum maculatum
Bryonia dioica
Carex hirta
C. nigra
C. otrubae
C. ovalis
Castanea sativa
Chenopodium rubrum
Cirsium vulgare
Epilobium montanum
Festuca ovina
Frangula alnus
Galium palustre
Hypericum perforatum
H. hirsutum
H. tetraspermum
Juncus conglomeratus
Juncus tenuis
Lamium album
Lathyrus pratensis
Leontodon autumnalis
Lychnis flos-cuculi
Melandrium rubrum
Mentha x verticillata
Myosotis arvensis
M. caespitosa
Orchis fuchsii
Poa pratensis
Populus tremula
Potentilla reptans
Ranunculus acris
R. aquatilis
Ribes rubrum
Salix fragilis
Scrophularia aquatica
Stachys officinalis
Veronica officinalis
Viburnum opulus

(3) Table III shows that the factor k in the Index of Diversity, which for an amalgamation of 3 samples involves only d, the difference in the proportions of species found in one sample only and of those found in all three samples, is not greatly affected by the diversity of the vegetation in the different areas, but is a measure of the variation in the samples forming the composite area. Since the value of the Index of Diversity can be obscured by this variation, d, and hence k, should lie within certain narrow limits. For example, the plains areas contain streams whose courses are marked by a belt of conspicuously different vegetation, and if one of the samples had consisted mainly of this belt, the value of d for the plains might have been too great to ensure the validity of the calculation of an Index of Diversity in comparison with other areas.

The numbers in column 6 depend on the contribution of each sample to the proportions p_1, p_2, p_3 and their correlation with the values of d, about 0·7, is not proved significant at the 5% level with these few results. Thus to base the rejection of IJK-L on a divergence of over 20% from the mean is a tentative suggestion, intended to suggest future lines of inquiry.

TABLE III

Column 1 Combined area	Proportion of species in: Column 2 One sample only (p_1)	Column 3 Exactly 2 samples (p_2)	Column 4 All 3 samples (p_3)	Column 5 d ($p_1 - p_3$)	Column 6 Maximum divergence from mean as % of mean
FGH	0·31	0·31	0·37	− 0·06	15
ABC	0·37	0·33	0·29	+ 0·08	18
IJK-L	0·48	0·26	0·26	+ 0·22	25
MST	0·43	0·22	0·35	+ 0·08	9
DEO	0·40	0·28	0·32	+ 0·08	9
PQR	0·37	0·25	0·38	− 0·01	13

$$k \log_e 3 = \frac{1+d}{2-d}$$

CONCLUSIONS

1. Areas similar in their vegetation types have been grouped together for investigation, and it is found that as the vegetation progresses to climax oakwood on Bookham common, the number of species of vascular plants is reduced to about two-fifths of that in the open areas. Conservation should therefore consist in checking the progress towards uniform oakwood. Scrub is periodically cleared, but it seems desirable also to delay the encroachment of woodland on scrub areas, if we wish to encourage a habitat favouring maximum variety of species. Clearing of woodland, however, can result in increase of bracken areas, and bracken is a great destroyer of variety.

2. The law that the *increment* in the number of species as area increases is proportional to log (area) is verified over a range of values of n for which it could *a priori* be expected to be valid, and a list of Indices of Diversity compiled for areas of differing vegetation types.

3. A list of the most widely distributed species on Bookham Common is given.

Thanks are due to the team who made the original survey and thus made this investigation possible: A. W. Jones, E. B. Bangerter, C. P. Castell, Mrs. J. F. Hall and P. C. Hall.

I should like to thank also P. A. Moxey, E. M. Forsyth and Dr. G. Beven for helpful suggestions, and particularly Mrs. A. Warren, who typed this paper and checked some of the details.

REFERENCES

CLAPHAM, A. R., TUTIN, T. G., and WARBURG, E. F., 1952. *Flora of the British Isles.* 1st Edition. Cambridge.
GREIG-SMITH, P., 1964. *Quantitive Plant Ecology.* 2nd Edition, London.
JONES, A. W., 1954. The Flora of Bookham Common. *Lond. Nat.*, 33, 25-47.
MORONEY, M. J., 1951. *Facts from Figures.* Penguin Books, Harmondsworth.
RUSSELL LANGLEY, 1968. *Practical Statistics.*

WILLIAMS, C. B., 1943. Area and Number of Species. *Nature*, **152**, 264-267.
WILLIAMS, C. B., 1944. Some Applications of the Logarithmic Series and Index of Diversity to Ecological Problems. *J. Ecol.*, **32**, 1-44.

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Some Recent Temporary Exposures of London Clay in the London Area

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INTRODUCTION

As London is an intensely built up area there are few permanent geological exposures available for study, excepting the one or two scheduled sites scattered around the Greater London perimeter. The London Clay which underlies much of the city can therefore only be studied by means of temporary exposures such as building sites, road works, etc. For this reason it is important to describe thoroughly as many temporary sites as possible, as failure to do so results in information being irretrievably lost. It is surprising, therefore, that so little has been published on the London Clay in this area, and that much of what has been published is inadequate. In many of the previous records the biotic (faunal and floral) lists are based entirely on fossils picked up in the field. This practice is unsatisfactory when dealing with lithologies which can be readily processed in the laboratory, as most of the smaller elements of the biota are overlooked. The lack of published information is probably due to the sparsely fossiliferous nature of the London Clay generally, and the necessity of collecting large samples to get a true idea of the biota present. In order to find out how fossiliferous the clay is to 30 mesh, the samples collected during this study were weighed dry, and the usable fossils obtained from the residue were weighed. It was found that on average it was necessary to collect 21·8 kg of dry clay to obtain 1 g of usable fossils. The authors have, therefore, tried to collect at least 20 kg of clay at each locality visited, although this has not always been possible.

It is the purpose of this and succeeding papers to try to make good this deficiency of published information, and eventually to draw conclusions about the stratigraphic and geographic distribution of the biotas. In this paper eight temporary and two semi-permanent exposures of London Clay from the London Area are described, and the biota from each listed. Next year we plan to continue by describing a further series of sites including the large excavation of the new Wraysbury Reservoir near Staines.

All localities are described in a standard format to allow easy information retrieval. Following the fossil names in the biotic lists are rough estimates of their relative abundance at each locality and their known range in the London Clay of the London Area based on Wrigley (1924 and 1940) with modifications on the evidence of material in the British Museum (Natural History). All sample weights quoted are of dry clay.

Wrigley was deliberately vague about where the junctions between successive divisions should be placed. This was due to the somewhat variable stratigraphic distribution of his diagnostic faunas above the Basement Bed, and is borne out by the present study. Even so, we have found that generally division 1 is restricted to the lowermost 50 ft. of clay, division 2 to the succeeding 140 ft. of clay, and division 3 to the next

60 ft. The transition from divisions 3 and 4 usually takes place at about 250 ft. above the Basement Bed, and the succeeding variable thickness of clay can be ascribed to division 4 up to the uppermost 50 ft. of the formation which falls in division 5.

A representative series of specimens has been deposited in the Department of Palaeontology, British Museum (Natural History) and where possible sieved concentrates between 30 and 200 mesh are being retained by one of us (A. J. R.) to permit future work on the microfossils.

1. BESSBOROUGH GARDENS, LONDON, S.W.1.

Locality: Site of the Brixton extension of Victoria Line (London Transport Underground railway) near Vauxhall Bridge.
Grid Reference: TQ 299783. Height (O.D.): 18 ft.
Contractors: Balfour Beatty Ltd.
Reported by: Jean Cooper.
Collectors: J. C., Mr. C. I. Macadie and A. J. R. (August 8, 1968).
Section: No section visible. A composite section for the area compiled from Geol. Surv. 6″ Maps is given below.

Made ground	16 ft.
Peaty clay	10 ft.
River Gravel	up to 18 ft.
London Clay	about 100 ft. thick

Lithology of London Clay: Typical stiff blue-grey pyritic clay with common flat concretions.

BIOTIC LIST: Based on the contents of a 56·1 kg sample collected from the clay tip (dug out from a depth of 90–95 ft.).

PROTOZOA
Undetermined foraminifera. Common. (1–5). A very diverse fauna is present.
BRACHIOPODA
Lingula tenuis J. Sowerby. Rare. (4–5).
BIVALVIA
Corbula globosa J. Sowerby. Rare. (3–5).
Nuculana amygdaloides (J. de C. Sowerby). Frequent. (2–5).
Pinna sp. (probably *P. affinis* J. Sowerby). Rare. (5).
GASTROPODA
Bathytoma granata (Edwards). Rare. (4–5).
Bulla sp. Rare. (3–5).
Euspira glaucinoides (J. Sowerby). Frequent. (2–5).
Streptolathyrus cymatodis (Edwards). Rare. (3).
SCAPHOPODA
"*Antalis*" *nitens* (J. Sowerby). Rare. (2–5).
CEPHALOPODA
Undetermined nautiloids. Frequent. (2–5). Seven specimens were reported by a workman.
ANNELIDA
Ditrupa plana (J. Sowerby). Frequent. (2–5).
ARTHROPODA
Undetermined ostracods. Frequent. (2–5).
ECHINODERMATA
Ophioglypha wetherelli (Forbes). Common. (2–5). Only disarticulated plates were found.
Indeterminate irregular echinoid fragments. Frequent. (5).
PISCES
Indeterminate lamnid tooth. Rare. (2–5).
Indeterminate teleost bones. Rare. (2–5).
(represented only by otoliths)

Brosmophycis sagittalis (Frost). Rare. (2–5).

Discussion: The Basement Bed varies in depth from −78 ft. to −130 ft. O.D. in the proximity of this site. The clay probably came from about 50 ft. above the base of the formation in the region of the junction between divisions 1 and 2. Although the fauna is not a diagnostic one we would prefer to refer it to division 2 as this division is generally characterised by an impoverished undiagnostic biota, whereas division 1 is usually unfossiliferous.

2. BRENTFORD, MIDDLESEX

Locality: Building site opposite the "Duke of York" public house, Brook Lane North, Brentford.

Grid Reference: TQ 177781. Height (O.D.): 40 ft.

Contractors: Rush and Tompkins.

Reported by: Mr. C. A. Walker.

Collectors: J. C., Mr. C. I. Macadie, A. J. R. and Mr. C. A. Walker (June 17–18, 1968).

Section: An approximate section was obtained from the drop corers.

Made ground	about 5 ft.
River Gravel	20 ft.
London Clay (not pierced)	25 ft.

Lithology of London Clay: Typical stiff blue-grey pyritic clay containing many concretions.

BIOTIC LIST: Based on the fossils collected on two occasions and on the contents of a 154 kg sample of clay.

PLANTAE (identifications of fruits verified by Dr. K. I. M. Chesters)
Undetermined hystrichospheres. Common. (4).
Anonaspermum commune Reid and Chandler. Rare. Only previously recorded from Sheppey, Kent.
Bowerbankella tiliacoroidea Reid and Chandler. Rare. Also only previously recorded from Sheppey, Kent.
Indeterminate wood fragments. Common. (2–5).
Copaline. Rare. (3–5). Only previously recorded from King George VI Reservoir, Stanwell, Middlesex and Highgate ("Highgate Resin").
PROTOZOA
Undetermined foraminifera. Abundant. (1–5). A diverse fauna is present.
COELENTERATA
Graphularia wetherelli Milne-Edwards. Rare. (2–5). Only the square form was found.
BRACHIOPODA
Lingula tenuis J. Sowerby. Rare. (4–5).
BIVALVIA
Amusium (*Lentipecten*) *corneum* (J. Sowerby). Rare. (4–5).
Anomia scabrosa S. V. Wood. Rare. (3).
Corbula globosa J. Sowerby. Frequent. (3–5).
Nemocardium semigranulatum (J. Sowerby). Rare. (3).
Nucula compressa J. de C. Sowerby. Rare. (3–5).
Nuculana amygdaloides (J. de C. Sowerby). Rare. (2–5).
?Ostrea sp. Rare. (3–5). One small juvenile found.
Pholadomya sp. (probably *P. margaritacea* (J. Sowerby)). Frequent. (3–5).
Pinna sp. (probably *P. affinis* J. Sowerby). Rare. (5).
Thracia sp. (probably *T. oblata* (J. de C. Sowerby)). Rare. Only previously recorded from Bognor Regis, Sussex in the London Clay.
Indeterminate teredinid tubes. Rare. (2–5). Two valve fragments also attributable to this family were found.
GASTROPODA
Adeorbis sp. Frequent. (3–5). Only known from Highate and Finchley in the London Clay.
Alvania sp. Rare. Not recorded from the London Clay.
Ancilla atrebatum Wrigley. Frequent. (3–5).
Bathytoma granata (Edwards). Rare. (4–5).
Bonellitia laeviuscula (J. Sowerby). Frequent. (2–5).
Bulla sp. Rare. (3–5).
Bullinella cf. *consors* (Deshayes). Rare. (3–5).
Eopleurotoma simillima (Edwards). Rare. (4–5).
Euspira glaucinoides (J. Sowerby). Frequent. (2–5).
Ficus (*Priscoficus*) *multiformis* Wrigley. Frequent. (3–5).
Lacuna sp. nov. Rare. This genus is unrecorded from the London Clay.
Litiopa sulculosa Edwards MS.. Rare. (5).
Odostomia spp. Frequent. (5).
Pseudoneptunea curta (J. de C. Sowerby). Rare. (4–5).
Ptychatractus interruptus (Pilkington). Rare. (3–5).

Ringicula turgida (J. Sowerby). Rare. (4–5).
Seila mundula (Deshayes). Rare. (3).
Tibia sublucida (Edwards). Frequent. Not previously recorded from the London Basin although there are specimens of this species labelled "*Tibia lucida*" in the British Museum collections from several London localities.
?Tornatellaea simulata (Solander). Rare. (3–5).
Volvula sp. Rare. New to the London Clay.
PTEROPODA
Spiratella mercinensis (Watelet and Lefèvre). Frequent. (2–5).
S. tutelina Curry. Rare. (3–5). Verified by Mr. D. Curry.
CEPHALOPODA (determined by Mr. D. Phillips)
Eutrephoceras regalis (J. Sowerby). Rare. (2–3). A specimen was found by a workman.
ANNELIDA
Ditrupa plana (J. Sowerby). Abundant. (2–5).
Rotularia bognoriensis (Mantell). Common. (3–5).
ARTHROPODA
Undetermined malacostracan claw fragments (?gen. nov.). Frequent. Conspecific with those found at Trans-World Hotels site (*q.v.*).
Indeterminate malacostracan claw fragment. Rare. (2–5).
Undetermined ostracods. Frequent. (2–5).
Euscalpellum minutum (T. Brown). Rare. (3–5).
ECHINODERMATA
Ophioglypha wetherelli (Forbes). Abundant. (2–5). Only disarticulated plates were found.
Indeterminate irregular echinoid fragments. Rare. (5).
PISCES
Heterodontus vincenti (Leriche). Rare. (3). This species has only been recorded from Worcester Park and Sheppey in the London Basin.
Isistius trituratus (Winkler). Rare. Only previously recorded from Bognor Regis and Sheppey in the London Clay of this country.
Indeterminate lamnid tooth. Rare. (2–5).
Indeterminate teleost bones. Frequent. (2–5).
(represented only by otoliths)
Apogon glaber Stinton. Rare. (2–3).
Cepola densa (Frost). Rare. (4–5).
Dinematichthys argutus Stinton. Frequent. (2–5).
Neobythites obtusus (Frost). Rare. (2–5).
Synodus davisi (Frost). Rare. (2–5).
Trachichthodes lemoinei (Priem). Rare. (2–5).
ICHNOFAUNA
Indeterminate faecal pellets. Common. No range known.

DISCUSSION: The clay available comes from between about 235 ft. and 260 ft. above the Basement Bed, and spans the junction between divisions 3 and 4. The rich biota also, is intermediate in character between these two divisions.

3. BRITISH MUSEUM (NATURAL HISTORY), LONDON, S.W.7.

LOCALITY: Two drop-coring sites within the grounds of the British Museum (Natural History), South Kensington.
GRID REFERENCE: TQ 267791. HEIGHT (O.D.): 25 ft.
CONTRACTORS: Pre-piling survey by Ministry of Public Building and Works.
COLLECTORS: J. C. and A. J. R. (June 21 and July 9, 1968).
SECTION: The section given below summarises the information from both sites.

Made ground and River Gravel	22 ft.
Weathered London Clay (brown)	1 ft.
Unweathered London Clay (not pierced) cored to 10 ft.	

LITHOLOGY OF LONDON CLAY: Typical stiff blue-grey clay.

BIOTIC LIST: Based entirely on specimens obtained from a 58·7 kg sample.

PLANTAE
Undetermined hystrichospheres. Common. (4).
Indeterminate wood fragments. Rare. (2–5).
PROTOZOA
Undetermined foraminifera. Abundant. (1–5). A varied fauna is present.
BRYOZOA (verified by Dr. C. T. Scrutton)
Batopora clithridiata (Gregory). Frequent. (5).

BRACHIOPODA
Terebratulina wardenensis Elliott. Rare. (2–3).

BIVALVIA
Thyasira goodhalli (J. de C. Sowerby). Rare. (2–5).
Indeterminate teredinid tubes. Rare. (2–5).

GASTROPODA
Bulla sp. Rare. (3–5).
Bullinella cf. *consors* (Deshayes). Rare. (3–5).
Euspira glaucinoides (J. Sowerby). Rare. (2–5).

ANNELIDA
Ditrupa plana (J. Sowerby). Rare. (2–5).

ARTHROPODA
Indeterminate coleopteran elytron. Rare. See note for *Venablesia* from Brixton.
Hoploparia gammaroides McCoy. Rare. (2–5). Only represented by a pincer fragment.
Indeterminate malacostracan claw (probably xanthid). Rare. (2–5).
Undetermined ostracods. Rare. (2–5).
Euscalpellum minutum (T. Brown). Rare. (3–5).

ECHINODERMATA
Undetermined crinoid arm plates. Rare.

PISCES
Notidanus serratissimus Agassiz. Rare. New to the London area. Only previously found at Sheppey and Bognor Regis.
Indeterminate lamnid tooth. Rare. (2–5).
Indeterminate teleost bones. Frequent. (2–5).
(represented only by otoliths)
Indeterminate brotulid otolith. Rare. (2–5). One worn fragment found.

ICHNOFAUNA
Indeterminate faecal pellets. Frequent. No range known.

DISCUSSION: The London Clay is about 185 ft. thick in this area. The biota is impoverished and non-diagnostic and thus corresponds with division 2. This probably represents the topmost few feet of division 2 on consideration of the height above the Basement Bed.

4. BRIXTON, LONDON, S.W.9.

LOCALITY: Victoria Line (London Transport Underground trains) shaft in Somerleyton Road, Brixton.

GRID REFERENCE: TQ 314752. HEIGHT (O.D.): 40 ft.

CONTRACTORS: A. Waddington & Son.

COLLECTORS: J. C. and A. J. R. (October 18, 1968).

SECTION: No section visible. The one given below is from the corner of Barnwell Road and Hamilton Road (Geol. Surv. 6″ Map).

Made ground	*c.* 3 ft.
Flood Plain Gravel	*c.* 5 ft.
London Clay (to base)	*c.* 150 ft.

LITHOLOGY OF LONDON CLAY: Typical massive blue-grey clay containing some tabular and some rounded concretions.

BIOTIC LIST: The specimens all come from a tip of clay dug out from 60 ft. below ground. A few specimens were found on the tip whilst in the field, but the majority of them were obtained from a 52 kg sample.

PLANTAE
Indeterminate wood fragments. Frequent. (2–5).

PROTOZOA
Undetermined foraminifera. Common. (1–5). A fairly diverse fauna is present.

COELENTERATA
Graphularia wetherelli Milne-Edwards. Rare. (2–5). One specimen of the square form was found.

BRACHIOPODA
Lingula tenuis J. Sowerby. Frequent. (4–5).

BIVALVIA
Nuculana amygdaloides (J. de C. Sowerby). Common. (2–5).
Thyasira goodhalli (J. de C. Sowerby). Rare. (2–5).

GASTROPODA
?Actaeon sp. Rare.
Alvania sp. Frequent. Not recorded from the London Clay.
Ancilla atrebatum Wrigley. Rare. (3–5).
Bulla sp. Rare. (3–5).
Euspira glaucinoides (J. Sowerby). Frequent. (2–5).
Lacuna sp. Rare. Not recorded from the London Clay.

PTEROPODA
Spiratella mercinensis (Watelet and Lefèvre). Common. (2–5).
S. cf. *taylori* Curry. Rare. (2–5). Two juveniles which probably belong to this species were kindly identified by Mr. D. Curry.

SCAPHOPODA (determined by Mr. C. P. Palmer)
Antalis anceps (J. de C. Sowerby). Rare. (2–3).
Gadila [*Cadulus*] sp. Rare. (5). Only known from Tolworth, Newnham, and Lower Swanwick.

ANNELIDA
Ditrupa plana (J. Sowerby). Common. (2–5).

ARTHROPODA
Venablesia cf. *colluvium* Britton. Rare. This and the specimen from the British Museum (Natural History) site are the first London Clay beetles to be recorded from a locality other than Bognor Regis in this country. They are also the first to be obtained by sieving the clay, those from Bognor come from wave-washed concentrates found on the foreshore (Venables and Taylor, 1963). This specimen is only tentatively referred to this species as the elytra are smooth, probably due to rolling.
Indeterminate malacostracan fragments. Common. (2–5).
Undetermined ostracods. Frequent. (2–5).

ECHINODERMATA
Ophioglypha wetherelli (Forbes). Common. (2–5). Only disarticulated plates were found.
Indeterminate irregular echinoid fragments. Rare. (5).

PISCES
Indeterminate teleost bones. Common. (2–5).
(represented only by otoliths)
Apogon glaber Stinton. Rare. (2–3).
Dinematichthys argutus Stinton. Rare. (2–5).
Synodus davisi (Frost). Rare. (2–5).

ICHNOFAUNA
Indeterminate faecal pellets. Common. No range known.

Discussion: As the London Clay is about 150 ft. thick in this area, the sample collected must have come from about 90 ft. above the base of the formation. This, and the nature of the fauna firmly places it within division 2.

5. DRURY LANE, LONDON, W.C.2.

Locality: Building site on the corner of Parker Street and Drury Lane.

Grid Reference: TQ 303812. Height (O.D.): 75 ft.

Contractors: Humphrey's.

Collectors: J. C. and Mr. J. J. Hooker (January 9, 1968).

Section:		ft.	ins.
Made ground	*c.*	16	0
Taplow Gravel		6	8
Weathered London Clay (brown)		1	3
Unweathered London Clay	seen to	1	8

Lithology of London Clay: Typical blue-grey clay with concretions.

BIOTIC LIST: This list is based almost entirely on the contents of a 0·5 kg sample.

PROTOZOA
Undetermined foraminifera. Frequent. (1–5).

COELENTERATA
Graphularia wetherelli Milne-Edwards. Frequent. (2–5). Only the round form found.

BRACHIOPODA
Lingula tenuis J. Sowerby. Rare. (4–5).

BIVALVIA
Nucula bowerbanki J. de C. Sowerby. Rare. (2–5).

SCAPHOPODA
"*Antalis*" *nitens* (J. Sowerby). Rare. (2–5).

PISCES
Indeterminate teleost tooth. Rare. This tooth is characteristic of the type called *Ardiodus marriotti* White, but as similar teeth can be found in several unrelated families of Recent teleosts we prefer to consider it as indeterminate.
Indeterminate teleost bones. Rare. (2–5).

DISCUSSION: The London Clay is about 100 ft. thick at this site, which, together with the undiagnostic fauna, places the clay sampled within division 2.

6. IMPERIAL COLLEGE, LONDON, S.W.7.

LOCALITY: Building site at W. end of block of Imperial College of Science and Technology, Imperial Institute Road, South Kensington.

GRID REFERENCE: TQ 26617922. HEIGHT (O.D.): 32 ft.

CONTRACTORS: Harry Neal Ltd.

REPORTED BY: Miss A. M. Davis.

COLLECTORS: J. C. and Mr. C. I. Macadie (July 15, 1968).

SECTION: As the section exposed was inaccessible the thicknesses given below are estimated.

Made ground	6–8 ft.
River Gravel	8–9 ft.
London Clay (bored to 50 ft. but not pierced)	*c.* 2 ft.

LITHOLOGY OF LONDON CLAY: Typical stiff blue-grey clay.

BIOTIC LIST: Based entirely on the contents of a 23·8 kg sample of clay.

PLANTAE
Undetermined hystrichospheres. Abundant. (4). "Large" hystrichospheres form a dominant element of the biota between 100 and 200 mesh.
Indeterminate wood fragments. Rare. (2–5).

PROTOZOA
Undetermined foraminifera. Abundant. (1–5). A very diverse fauna is present.

COELENTERATA
Graphularia wetherelli Milne-Edwards. Frequent. (2–5). About equal numbers of square and round forms are present.
Octacoral spicules. Rare. This is probably a new record for the London Clay.

BRYOZOA (verified by Dr. C. T. Scrutton)
Batopora clithridiata (Gregory). Rare. (5).

BRACHIOPODA
Terebratulina wardenensis Elliott. Frequent. (2–3).

BIVALVIA
Nucula compressa J. de C. Sowerby. Rare. (3–5).
Venericardia sp. Rare. (5). One small fragment found.

GASTROPODA
Bullinella cf. *consors* (Deshayes). Rare. (3–5).
Euspira glaucinoides (J. Sowerby). Rare. (2–5).

ANNELIDA
Ditrupa plana (J. Sowerby). Frequent. (2–5).
?Sclerostyla sp. Rare. (4–5). Only a fragment of a small tube was found.
Undetermined annelid jaws (scolecodonts). Rare. No range known.

ARTHROPODA
Undetermined ostracods. Rare. (2–5).

ECHINODERMATA
Ophioglypha wetherelli (Forbes). Rare. (2–5). Only disarticulated plates were found.
Indeterminate irregular echinoid plates. Rare. (5).

PISCES
Indeterminate selachian tooth fragment. Rare. (2–5).
Indeterminate teleost bones. Frequent. (2–5).
(represented only by otoliths)
Dinematichthys argutus Stinton. Rare. (2–5).
Neobythites obtusus (Frost). Rare. (2–5).

ICHNOFAUNA
Indeterminate faecal pellets. Common. No range known.

Discussion: This clay must come from the top of division 2 for the same reasons as those given for the British Museum (Natural History) site.

7. ISLEWORTH, MIDDLESEX

Locality: Exposure on Thames foreshore opposite W. end of Syon Park, Isleworth.

Grid Reference: TQ 170761. Height (O.D.): about 5 ft.

Reported by: This locality came to our notice because Mr. John Miller found a well preserved tooth of *Lamna obliqua* (Agassiz) here and presented it to the Department of Palaeontology, British Museum (Natural History) (registration number P.46776). Mr. H. A. Toombs then showed the specimen to one of the authors.

Collectors: A. J. R., Mr. E. P. Rundle and Miss B. H. Rundle (1964-1968).

Section: No section exposed. The London Clay occurs in patches on the foreshore where the overlying River Gravels have been eroded away.

Lithology of London Clay: Typical stiff blue-grey clay with a layer of large concretions.

BIOTIC LIST: Based mainly on specimens obtained on about twenty visits to the site.

PLANTAE
Indeterminate wood fragments. Common. (2–5).

PROTOZOA
Undetermined foraminifera. Common. (1–5).

COELENTERATA
Graphularia wetherelli Milne-Edwards. Rare. (2–5). Only the square form was found.

BIVALVIA
Abra splendens (J. de C. Sowerby). Frequent. (2–5).
Amusium (*Lentipecten*) *corneum* (J. Sowerby). Rare. (4–5).
Corbula globosa J. Sowerby. Abundant. (3–5).
Cuspidaria inflata J. de C. Sowerby. Rare. (3–5).
Glycymeris wrigleyi Curry. Rare. (2–5).
Nemocardium semigranulatum (J. Sowerby). Rare. (3).
Nucula compressa J. de C. Sowerby. Frequent. (3–5).
Nuculana amygdaloides (J. de C. Sowerby). Frequent. (2–5).
Indeterminate teredinid tubes. Rare. (2–5).

GASTROPODA
Bathytoma granata (Edwards). Rare. (4–5).
Bonellitia laeviuscula (J. Sowerby). Frequent. (2–5).
Bulla sp. Rare. (3–5).
Bullinella cf. *consors* (Deshayes). Rare. (3–5).
Eopleurotoma simillima (Edwards). Frequent. (4–5).

Epitonium primaevum Cossmann. Rare. (5).
Euspira glaucinoides (J. Sowerby). Common. (2–5).
Euthriofusus crebrilineus Wrigley. Frequent. New to the London Basin.
E. transversarius Wrigley. Frequent. (3–5).
Ficus (*Priscoficus*) *multiformis* Wrigley. Common. (3–5).
Hemipleurotoma prestwichi (Edwards). Rare. (3–5).
H. taeniolata (Edwards). Rare. (4).
Odostomia sp. Rare. (5).
Pseudoneptunea curta (J. de C. Sowerby). Common. (4–5).
Ptychatractus angusta (Deshayes). Frequent. (5). This species is unrecorded from the London Clay although there are specimens of it from Highgate in the British Museum collections, previously included with *P. interruptus*. Its presence was kindly pointed out by Mr. C. King.
P. interruptus (Pilkington). Frequent. (3–5).
Ringicula turgida (J. Sowerby). Rare. (4–5).
Seila mundula (Deshayes). Rare. (3).
Sinum clathratum (Gmelin). Rare. (2–5).
Solariaxis pulcher (J. de C. Sowerby). Frequent. (2–5).
Surculites errans (Solander). Rare. (3–5).
Tibia sublucida (Edwards). Common. See note under Brentford.
Turricula symmetrica (Edwards). Rare. (3–5).
T. teretrium (Edwards). Rare. (4–5).
Volutocorbis elevata (J. Sowerby). Rare. (3–5).

CEPHALOPODA
Indeterminate nautiloid fragments. Rare. (2–5).

ANNELIDA
Ditrupa plana (J. Sowerby). Abundant. (2–5).

PISCES
Albula oweni (Owen). Rare. (4). One worn tooth found. Only previously known from Bracknell, Sheppey and Bognor Regis.
Lamna obliqua (Agassiz). Rare. (3). See under "Reported by" for details.
Myliobatis cf. *toliapicus* Agassiz. Rare. (5). One well preserved median tooth found. Only previously recorded from Highate and Sheppey.
Indeterminate lamnid teeth. Rare. (2–5).
Indeterminate teleost bones. Rare. (2–5).
(represented only by otoliths, (verified by Mr. F. C. Stinton)
Apogon glaber Stinton. Rare. (2–3).
Cepola densa (Frost). Rare. (4–5).
Dinematichthys argutus Stinton. Rare. (2–5).
Pterothrissus angulatus Stinton. Rare. (2–5).

DISCUSSION: The London Clay is about 360 ft. thick in this area. This places the clay exposed well within division 4, although the biota is very similar to that from Brentford.

8. KEW RAILWAY BRIDGE, SURREY

LOCALITY: Exposure on Thames foreshore, south side, about 100 yards W. of the bridge.

GRID REFERENCE: TQ 195775. HEIGHT (O.D.): about 5 ft.

REPORTED BY: Occurrence noted in Porter (1936).

COLLECTOR: A. J. R. (1964-1968).

SECTION: No section visible. The fossils were collected from the vicinity of weathered London Clay visible between boulders on the foreshore. The London Clay is overlain by River Gravels.

LITHOLOGY OF LONDON CLAY: Only very weathered orangey clay seen.

BIOTIC LIST: Porter records the presence of *Rotularia bognoriensis* (Mantell), but unfortunately this could not be verified. The specimens listed here were collected on about a dozen visits to the site.

PLANTAE
Indeterminate wood fragments. Frequent. (2–5).

BIVALVIA
Indeterminate teredinid tubes. Rare. (2–5).

CEPHALOPODA (determined by Mr. D. Phillips)
Nautiloid (probably *Cimomia imperialis* (J. Sowerby)). Rare. (2–5).

ANNELIDA
Ditrupa plana (J. Sowerby). Frequent. (2–5).

ARTHROPODA
Dromilites bucklandi Milne-Edwards. Rare. (3–5).

PISCES
Indeterminate teleost bones. Rare. (2–5).

DISCUSSION: The London Clay is about 240 ft. in this region, thus placing the exposed clay close to the junction between divisions 3 and 4. The biota is not sufficiently well known to be any more precise.

9. LONDON AIRPORT, MIDDLESEX

LOCALITY: Site of a new roundabout N. of the main entrance to London Airport.

GRID REFERENCE: TQ 075770. HEIGHT (O.D.): 85 ft.

CONTRACTORS: Costain.

COLLECTORS: Dr. D. D. Bayliss, Mr. C. P. Nuttall and Mr. E. P. Smith (July 8, 1963).

SECTION: No section was recorded.

LITHOLOGY OF LONDON CLAY: Dark greenish-grey to brownish-grey clay.

BIOTIC LIST: Based entirely on specimens collected in the field.

PLANTAE
Indeterminate wood fragments. Rare. (2–5).

BRACHIOPODA
Terebratulina wardenensis Elliott. Frequent. (2–3).

BIVALVIA
Abra splendens (J. de C. Sowerby). Rare. (2–5).
Arca cf. *impolita* J. de C. Sowerby. Frequent. (3–5).
Arctica planata (J. de C. Sowerby). Rare. (3–4).
Nuculana amygdaloides (J. de C. Sowerby). Frequent. (2–3).
Ostrea gryphovicina S. V. Wood. Rare. (3–5).
Pteria media (J. Sowerby). Frequent. (3–5).
Thyasira goodhalli (J. de C. Sowerby). Rare. (2–5).
Indeterminate teredinid tubes. Frequent. (2–5).

GASTROPODA
Aporrhais sowerbii (Fleming). Frequent. (3–5).
Bathytoma granata (Edwards). Frequent. (4–5).
"*Cassis*" *striata* J. Sowerby. Frequent. (3–5).
Daphnobela junceum (Solander). Rare. (3–5).
Eopleurotoma simillima (Edwards) var. *crassilinea* Edwards. Frequent. (3).
Euspira glaucinoides (J. Sowerby). Frequent. (2–5).
Euthriofusus transversarius Wrigley. Rare. (3–5).
Ficus (*Priscoficus*) *multiformis* Wrigley. Frequent. (3–5).
Murex subcristatus d'Orbigny. Rare. (4–5).
Orthochetus elongatus Wrigley. Frequent. (2–4).
Scaphella wetherelli (J. de C. Sowerby). Rare. (3).
Solariaxis pulcher (J. de C. Sowerby). Rare. (2–5).
Streptolathyrus cymatodis (Edwards). Frequent. (3).
Surculites errans (Solander). Rare. (3–5).
Tibia sublucida (Edwards). Rare. See note under Brentford.
Turricula helix (Edwards). Frequent. (3).

CEPHALOPODA
Cimomia imperialis (J. Sowerby). Rare. (2–5).

ANNELIDA
Rotularia bognoriensis (Mantell). Frequent. (3–5).

ARTHROPODA
Indeterminate malacostracan claw (probably xanthid). Rare. (2–5).
Euscalpellum minutum (T. Brown). Rare. (3–5).

PISCES
Indeterminate lamnid tooth. Rare. (2–5).
(represented only by otoliths)
Trachichthodes lemoinei (Priem). Rare. (2–5).

ICHNOFAUNA
Indeterminate faecal pellets. Abundant. No range known.

DISCUSSION: It appears that there are no borehole records to the base of the formation from the near vicinity of this site, but it is probably of the same horizon as at the King George VI Reservoir, Stanwell (Wrigley, 1940) which is nearby. The typical division 3 biota listed above confirms this.

10. TRANS-WORLD HOTELS SITE, LONDON, S.W.5.

LOCALITY: Building site between Cromwell Road and Knaresborough Place, South Kensington.

GRID REFERENCE: TQ 257788. HEIGHT (O.D.): 30 ft.

CONTRACTORS: Taylor Woodrow.

REPORTED BY: Miss A. M. Davis.

COLLECTORS: J. C. and Mr. C. I. Macadie (September 10, 1968).

SECTION: No section visible. The clay studied was removed from a skip outside the site, the clay coming from 75–90 ft. below the road.

LITHOLOGY OF LONDON CLAY: Typical stiff blue-grey clay.

BIOTIC LIST: Based on specimens obtained from a 50·3 kg sample of clay

PLANTAE
Undetermined hystrichospheres. Common. (4).
Indeterminate wood fragments. Frequent. (2–5).

PROTOZOA
Undetermined foraminifera. Abundant. (1–5). A very diverse fauna is present.

COELENTERATA
Graphularia wetherelli Milne-Edwards. Rare. (2–5). Only the round form was found.

BRYOZOA (verified by Dr. C. T. Scrutton)
Adeonellopsis sp. Rare.
Batopora clithridiata (Gregory). Rare. (5).

BRACHIOPODA
Lingula tenuis J. Sowerby. Rare. (4–5).

BIVALVIA
Anomia scabrosa S. V. Wood. Rare. (3). One fragment found.
Pecten duplicatus J. de C. Sowerby. Frequent. (3–5). Only fragments found.
Indeterminate teredinid tubes. Rare. (2–5).

GASTROPODA
Bonellitia sp. Rare. (2–5).
Crenilabium sp. Rare. (4).
Euspira glaucinoides (J. Sowerby). Rare. (2–5).

PTEROPODA
Spiratella taylori Curry. Rare. (2–5).

SCAPHOPODA
Antalis anceps (J. de C. Sowerby). Rare. (2–3).
"*A.*" *nitens* (J. Sowerby). Rare. (2–5).

ANNELIDA
Ditrupa plana (J. Sowerby). Common. (2–5).

ARTHROPODA
Undetermined malacostracan claw fragments (?gen. nov.). Frequent. Conspecific to those found at Brentford (q.v.).
Indeterminate malacostracan claws (probably xanthid). Rare. (2–5).
Undetermined ostracods. Frequent. (2–5).

ECHINODERMATA
Cainocrinus tintinnabulum Forbes (=*Pentacrinus oakeshottianus* Forbes). Frequent. (3–5). Confirmed by Mr. H. G. Owen.

PISCES
Squalus minor (Daimeries). Rare. (3).
Indeterminate carcharinid tooth fragment. Rare. (2–5).

Indeterminate teleost bones. Frequent. (2–5).
(represented only by otoliths)
Indeterminate otolith. Rare. (2–5). A very worn specimen was found.
ICHNOFAUNA
Indeterminate faecal pellets. Common. No range known.

DISCUSSION: The Basement Bed is at about —170 ft. O.D. in this area, so the clay collected must come from between about 110 and 125 ft. above the base of the formation. This and the non-diagnostic biota prove it to be from division 2.

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REFERENCES

PORTER, E. M., 1936. A Record of a new outcrop of London Clay, near Kew, Surrey. *Proc. Geol. Ass.*, **47**, 269.

VENABLES, E. M. and TAYLOR, H. E., 1963. An Insect Fauna of the London Clay. *Proc. Geol. Ass.*, **73**, 273-279.

WRIGLEY, A., 1924. Faunal Divisions of the London Clay, illustrated by some exposures near London. *Proc. Geol. Ass.*, **35**, 245-259.

———, 1940. The faunal succession in the London Clay, illustrated in some new exposures near London. *Proc. Geol. Ass.*, **51**, 230-245.

(*Received February 1969*)

Further Additions to the London Clay Biota of Oxshott, Surrey

By Adrian J. Rundle and John Cooper

(*Department of Geology, University of Nottingham, and Department of Palaeontology, British Museum* (*Natural History*))

INTRODUCTION

The pit of the Oxshott Brickworks Ltd. near Oxshott, Surrey (TQ 133602) is probably the best known inland exposure of London Clay in the London Basin. The intensive study of the pit between the years 1951 and 1955 by members of the Geology Section of this Society resulted in the accumulation of a large number of macrofossil specimens. On the basis of these Brown and Castell (1954 and 1955) were able to record a total of forty-six species belonging to six phyla. They concluded on faunal and lithological grounds that the clay exposed belonged to Wrigley's (1924 and 1940) division 5 of the London Clay of the London Basin. At about the same time five species of foraminifera were listed by Bowen (1954) in his general work on the London Clay foraminifera. This list was considerably enlarged a few years later by Hampton (1957) who recorded a further twenty-six species of foraminifera. The most recent additions to the fauna are the four species of teleost otoliths listed by Stinton (1966).

Since the publication of Brown and Castell's work Mr. Castell received several more unrecorded species of mollusca from members of the Society. It was Mr. Castell's intention to publish these, especially as the pit is now filled with water and geologically inaccessible. Unfortunately this has not been possible and the task has been entrusted to the present authors. The list presented below includes these additions together with others obtained as a result of processing some remaining concretions in the British Museum (Natural History).

We would like to express our sincere thanks to Mr. C. P. Castell for all his help and encouragement to both authors over the past few years. We would also like to acknowledge Messrs. J. Mitchell and J. W. Simons for collecting some of the material studied for this note, and Mr. J. S. H. Collins for supplying the additional arthropod records.

The format of the list remains the same as that used by Brown and Castell (1954 and 1955). The specimens are deposited in the Department of Palaeontology, British Museum (Natural History).

BIOTIC LIST

PLANTAE

Undetermined diatoms. Frequent. (1). Several pyritic moulds probably referable to *Coscinodiscus* (preserved on a cavity slide).

BIVALVIA

Abra splendens (J. de C. Sowerby). Rare. (2–5).
Nucula sp. indet. Rare. (2–5).

GASTROPODA

Architectonica bistriata (Deshayes). Rare. (4–5).
Bonellitia laeviuscula (J. Sowerby). Rare. (2–5).
B. subevulsa (d'Orbigny). Rare. (5).
Eocypraea oviformis (J. Sowerby). Rare. (3–5).
Eopleurotoma wetherelli (Edwards). Rare. (4–5).
Eulima ferroviae Wrigley. Rare. (5).
Euthriofusus (*Wrigleya*) *transversarius* Wrigley. Frequent. (3–5).
Fusinus coniferus (J. Sowerby). Rare. (5).
Hemipleurotoma macrobia (Edwards). Rare. (2–5).

Litiopa sulculosa (Edwards MS.). Rare. (5).
Murex subcoronatus d'Orbigny. Rare. (4–5).
M. subcristatus d'Orbigny. Rare. (3–5).
Sassia morrisi Wrigley. Rare. (3–5).
Scalaridae sp. undet. Rare. (2–5).

CEPHALOPODA (determined by Mr. D. Phillips)
?*Deltoidonautilus sowerbyi* (J. de C. Sowerby). Rare. (3). Not definitely determinate as only the crushed nuclear whorls are present.

ANNELIDA
Undetermined annelid jaws (scolecodonts). Rare. (2).

ARTHROPODA (determined by Mr. J. S. H. Collins)
Dromilites lamarcki (Desmarest). Rare. (3–5).
Portunites incerta Bell. Rare. (2–5).

ECHINODERMATA
Indeterminate stellaroid plate. Rare. (2–5).

REFERENCES

BOWEN, R. N. C., 1954. Foraminifera of the London Clay. *Proc. Geol. Ass.*, **65** (2), 125-174, 4 figs., 1 chart.

BROWN, M. M. and CASTELL, C. P., 1954. The London Clay of Oxshott, Surrey. *Lond. Nat.*, 33, 61-64.

———, 1955. Additions to the London Clay Fauna of Oxshott, Surrey. *Lond. Nat.*, 34, 46-48.

HAMPTON, J. S., 1957. A Foraminiferal Assemblage from the London Clay of Oxshott, Surrey. *Lond. Nat.*, 36, 25-28.

STINTON, F. C., 1966. *Fish Otoliths from the London Clay.* Appendix in E. CASIER: *Faune Ichthyologique du London Clay* (pp. 404-478, pls. 66-68). London (Brit. Mus. (Nat. Hist.)).

WRIGLEY, A., 1924. Faunal Divisions of the London Clay, illustrated by some Exposures near London. *Proc. Geol. Ass.*, **35** (3), 245-259.

———, 1940. The Faunal Succession in the London Clay, illustrated in some New Exposures near London. *Proc. Geol. Ass.*, **51** (3), 230-245.

(*Received August* 1969)

Conservation Report 1969

By DAPHNE C. HERSEY

(Secretary, London Nature Conservation Committee)

LOOKING back on this year, probably the most important event is the beginning of the revision by the Nature Conservancy of Sites of Special Scientific Interest in the Greater London Area. Forms are provided by the Conservancy and all proposals must be submitted to Mrs. Small by early 1970, to be inspected later by Conservancy staff. There will be full details in next year's Conservation report.

As usual in the London Area we have been much occupied with roads and water. Our Chairman, Mr. Milne-Redhead, is in the forefront of yet another battle to save a Surrey Common—this time Mitcham. Mr. Berry, Deputy Director of Parks for the London Borough of Merton, produced a far-seeing scheme for the reconstitution of a natural type of woodland and heathland vegetation on the Common, comparable to that on Wimbledon Common. To do this, the A road from Croydon would need to be moved to the Southern boundary of the Common, and its interchange with the M23 moved a hundred yards south. The scheme was favourably received by the Common Conservators, the Committee, and the Surrey Naturalists Trust. Our Chairman then submitted it to the Ministry of Transport who had no objection to it in principle but stated that the extra money it would require was not available in the Motorway funds. It was then submitted to the Nature Conservancy, to the Greater London Council's Department of Planning and Transportation, and to the Member of Parliament for Mitcham. Now, at the close of the year, it is still under consideration by the Greater London Council, and Mr. Berry is hoping to get some publicity for it in the national press.

Pressure by other amenity groups on stretches of water continues, sometimes but not always, leading to a conflict of interests with naturalists. Sporting activities such as water ski-ing are detrimental to wild life, but those who pursue them usually have more money than naturalists organisations and are often more willing to use their money to further their own interests. It is becoming increasingly apparent that in order to protect gravel pits and other water centres of wild life, naturalists are going to have to find more money and not take their use for granted. The Committee were asked to lend their support to the Berkshire, Buckinghamshire and Oxfordshire Naturalists Trust in opposing plans for water ski-ing on gravel pits adjoining the Old Slade Lane Nature Reserve—water which in winter holds up to 1,000 duck. This complex of pits is of primary importance in the Colne Valley area, but although the naturalists objections to the London Ski Club's scheme were discussed by Eton Rural District Council, the proposal to develop the pits was allowed by a narrow majority. This was not however the end of the matter for much to our pleasure this decision was reversed by the Minister and the pits are now safe.

Mr. Milne-Redhead on behalf of the Surrey Naturalists Trust, has advised the South-East region of the Nature Conservancy that it would be wise not to extend permission for sailing on the gravel pit at Staines Moor for more than one year. Following a meeting between the Chief Supplies

Engineer, members of this Committee and the Ornithological Section, it was stated that restricted sailing is to be allowed on the King George VI Reservoir for an experimental period and that for the time being there would be no further recreational use of the other Metropolitan Water Board reservoirs. Walthamstow Reservoirs are now being drained for restoration, and it is hoped that some protection can be given to the heronry there.

Angling does not usually present a clash of interests with natural history, and when Mr. Milne-Redhead received a letter from the secretary of the Bath Road Piscatorial Society expressing concern at the proposed development of Hithermoor Road Pit, Stanwell Moor, as a nature reserve, he was able to reassure him, pointing out that in two of the Surrey Trust reserves, the fishing rights were let out to angling clubs, and that with a wardening system there could be direct benefit to both interests. Observers are studying the Bugle Gravel Pit, Shepperton, prior to its being made a nature reserve which it is hoped will be run by the Surrey Trust with London Weekend Television.

A letter was received from the Thamesside Research and Development Group enquiring into the effect on bird life between Richmond and Greenwich if the proposed Thames Barrage comes into being and the mud flats are permanently covered with water. The Committee stressed the importance of the Thames reach between Brentford and Isleworth adjoining Syon Park where is the only natural river bank of the tidal Thames above London with the creeks and swampy land adjacent to it making it an ideal feeding ground for birds. This is an SSSI and the large amount of mud exposed at low tide makes it a popular sheltering ground for duck and waders. If the tidal flow is completely stopped, it will be less attractive, but if solitude remains, the Tide Meadow at Syon will still be congenial to some birds, especially heron and snipe, and should not affect the rare tree roost of the cormorants.

It is pleasing that some landowners as well as the Naturalists Trusts are anxious to improve their land for nature conservation management. Mr. Milne-Redhead was asked to discuss conservation with the Duke of Northumberland's agent at Syon. The Duke wishes to leave the Park in its natural state but is worried about river bank erosion due to the increased speed of river craft. Methods of bank stabilisation are being enquired into. At Wimbledon, the Nature Conservancy has submitted a report on management and wild life, and at Mitcham the Superintendent of Parks, and Merton Borough staff have a plan for restoring spoilt areas. The Conservators of Petersham Common have employed a firm for selective clearing and an excellent job has been done. At the Godstone Reserve angling is now possible since weeds were cleared with "Aqua-death". It is thought that this weed could be the result of silting and a floating gate may be the answer to it. Mr. R. Clarke who does such sterling work there has appealed for volunteers to pull up marginal weed in order to preserve such rarities as *Rumex maritimus* and *Berula erecta.* The National Trust is helping to clear Hawthorn scrub at South Hawke, and at Happy Valley near Farthing Down, the London Borough of Croydon's cutting of Hawthorn and Dogwood has led to an increase in chalk flora.

A most interesting experiment in conservation is being carried out by Mr. Milne-Redhead on behalf of L.N.H.S., with the scheme to reintroduce Bluebells to urban woodlands. Following his appeal in the May edition of *Wildlife and the Countryside*, over half a million seeds have been sent by readers from all over the country. When it is borne in mind that there are 6,490 seeds in an ounce, it is apparent that the public response was very gratifying. Half of these are to be sown mixed in sand at the foot of Star and Garter Hill and the main road in Richmond, whilst the rest will be grown in Highgate Wood. This is one of many proofs that public interest in natural history continues and with leadership and direction a great deal can be achieved.

The Godstone Reserve had 400 visitors on its Open Day and the Nature Trail at Ranmore was one of several run by Trusts this summer which proved very popular. Greenwich Council are proposing to set aside part of the new Thamesmead land as a nature reserve—a far-sighted measure if it is well-managed and maintained in a wild state. It is hoped that in due course there will be a small educational Nature Reserve on Petersham Common, Surrey, and in the same county, the grounds of Fairdean School, Chipstead, are virtually a private nature reserve.

Members of the Committee have learned a great deal more about Geology since the President, Mr. Butler, joined us to represent Geological interests, and we have learnt too how easily geological sites can be completely lost through lack of public interest, and mismanagement by local councils. At Bexley, Wansunt Pit has been taken off the list of Sites of Special Scientific Interest because its interest has declined with rubbish tipping which made suitable maintenance difficult. In the same area, at Perry Street, Crayford, one of the brickearth pits at the recreation ground has been filled in and another used for rubbish dumping. Because of the state of Radlett-Newberries Park pit, none of the "pudding stone" for which it was known can be seen, and again in Hertfordshire, the Potterscrouch chalk pit near St. Albans is in a poor state. The Radlett pits are probably beyond recovery. It is not surprising that the Nature Conservancy, aware of the lack of care from which so many geological sites suffer, is circulating pamphlets concerning this to the County Trusts. Children are sometimes another problem in sandpit areas. At Charlton, some erosion is caused by children who gain unauthorised entry, and repairs to fencing and extra supervision during weekends and holidays will help to combat this. The attention of teachers in charge of parties will be drawn to the need to control the behaviour of children on the slopes. There has been a great deal of correspondence with the Geologists Association, the G.L.C., and other bodies concerning this sandpit which is a site of national geological importance, for it was thought that its future could be insecure if transferred by the G.L.C. to the London Borough of Greenwich as is likely to happen if Maryon Park itself is transferred. The attention of the Council's solicitor is to be drawn to the special nature of the site and in consultation with the Borough the safe-guarding of the geological formation will be stressed.

Mrs. Small and Mr. Milne-Redhead were present at the Joint Planning meeting of the South Eastern Trusts and the Nature Conservancy, the first meeting dealing with broad principles of planning for conservation in the South-East. Although the only parts of the Society's area discussed were the North Downs and the Colne Valley, this was most informative. The Special Conference on gravel pits, mineral workings and land reclamation arranged by the River Thames Society and Thames Planning and Amenities Forum was attended by Mrs. Small on April 17, and Mr. Milne-Redhead was the L.N.H.S. representative at the

Corporation of the City of London's meeting to launch the new Conservation Centre to be established in Epping Forest. It was with pleasure that we learnt of the appointment of Mr. Paul Moxey, until recently a member of this Committee, as Warden of the new £70,000 Centre due to be opened in 1970.

1970 is of course, European Conservation Year, and the Trusts are very busy organising lectures, courses, films, public meetings of all kinds, exhibitions, and nature trails. The Society's work in this direction has been undertaken by Mrs. Small, and an excellent and very full programme awaits us. However, to quote the wartime tag—"It all depends on you"—on all of us—not only to maintain public interest, but also to see that sites worthy of conservation really are conserved and protected.

Obituary

LEONARD PARMENTER, 1903-1969

With the death of our Honorary Vice-President Len Parmenter on March 4 1969, the Society lost one of its most devoted members. He was one of the giants of our post-war reconstruction, and with his administrative ability, fertile mind and tireless energy he did as much as anyone to bring about the huge growth in our membership in the years between 1944 and 1952.

Parmenter was one of the leading amateur entomologists of his day, but his achievements in this specialised field have been recorded elsewhere (1969, *Ent. Record*, Vol. **81,** 182-4). The purpose of these notes is to pay tribute to his services to our Society, of which he was a member for 44 years. During this long period he held office of one sort or another for no less than 40 years, broken only by his military service during the Second World War.

His forte lay in field natural history, and throughout his membership he regularly attended and led field meetings, largely in his favourite county of Surrey. He also spoke frequently at indoor meetings, while his contributions to the *London Naturalist* began in 1937 and continued until 1968: in all, he wrote 17 papers for our journal, of which his series of three papers on the Diptera (Flies) of Bookham Common have become widely recognised as a classic of their kind.

His encouragement of young members should also be recorded. He went out of his way, year after year, to invite young entomologists to join our Society, to speak to any new faces he noticed at meetings, and in every way to foster the interest of beginners in natural history.

His financial training and abilities enabled him to serve the Society as Treasurer and as a trustee for our investments over a number of years.

Those of us who served with and under him on the Council of the Society will remember the wise and calm lead he so often gave us. There were those at Council meetings who could be relied on to parade their hobby-horses, and there were those, more welcome, who frequently lightened our discussions by shafts of wit. Parmenter was in neither of these camps. He would sit stolidly hunched up in his place, absorbing the arguments, which were sometimes heated and apparently irreconcilable; and then he would weigh in, with his characteristic matter-of-fact earthiness tinged with a dry humour, and propose a constructive solution which often met with general acceptance. He so clearly had the long-term well-being of the Society foremost in his mind that his opinions always carried a good deal of weight. Moreover, he was felt to be highly qualified to pronounce on issues which cut across sectional boundaries by reason of his long experience and active participation in no less than three of the Society's Sections, including the very important Ornithological Section.

Even after he retired to the New Forest in 1966 he continued in correspondence to take a close interest in our affairs. With his untimely death from heart trouble many of us lost a counsellor to whom we had long been used to turn for advice on so many problems.

R. M. Payne

A tribute to L. Parmenter

LEN PARMENTER and myself joined the Society within a few weeks of each other in the winter of 1925/26, both of us as keen ornithologists Immediately on joining the Society, Parmenter began to report the bird species for the Inner London parks and reservoirs to the Recorder, Mr. A. Holte MacPherson. Soon he took over the Recording himself, in 1929.

For the first ten years, Len Parmenter was devoted to the interests of the Ornithological Section. In turn he was Field Meeting Secretary, Recorder for four years, Curator and finally Chairman, both before and again, after the War. For 15 years he served on the Section Committee. In all these posts he helped tremendously to promote the active field work, for which our Society is famous.

At the end of five years, Parmenter had also taken up the study of the Diptera, and was elected to the Entomological Section as a Committee member in 1935. As I was on the same committees, we again met frequently, and I can testify to how rapidly the Section expanded in numbers and usefulness, owing to his enthusiasm. We also often met on the same rambles, or helped to record in the same Surveys. He was an exceedingly delightful, gay and informative companion.

Within a couple of years of joining, and until our respective retirements from the London Area, we were both actively engaged in the administration of the Society, first as members of the same Sections, and then on the Council. I therefore saw a good deal of Parmenter, while he occupied in due course several secretarial and other posts, and we all came to rely tremendously on him.

In 1936 the Society founded an Ecology Section, to which Parmenter became Secretary. The first survey initiated was to Limpsfield Common, Surrey and he compiled the yearly reports and also published in the Society's Journals, lists of the Diptera taken on the survey. When in 1941, the ecologists were obliged to switch to Bookham Common, Parmenter took on the Diptera of that survey, with the same thoroughness and enthusiasm. All this work had to be suspended however, from 1943 to 1946, because of his enforced absence from the London Area. He also resigned all the Society posts.

I did not see him again till the winter of 1945, when he was home once more to Thornton Heath. He was elected Chairman of the Ecology Section and a committee member of the Entomology Section, 1946 and back on Council 1947. For three years from 1949 he was the Society's President and for the following five years, the Treasurer. He was elected Vice-President in 1957, the year I left England for good.

For all these 30 years, and in every post he held, no-one could have been more efficient, constructive, imaginative, helpful and dependable. The Society owes him a very great debt.

CYNTHIA LONGFIELD

Books

The Victorian Fern Craze, by D. E. Allen. 83+xii pages. Hutchinson of London, 1969. 21s.

This interesting essay on the origins and course of the Victorian obsession with ferns is well worth the attention of naturalists who can take a detached view of their hobby. Mr. Allen has done a great deal of research into his subject, so that for instance we learn that Ward, for all his fame, was by no means the first to grow ferns in glass cases; and that the removal of the excise duty on glass in 1845 had a marked effect on the development of fern cultivation. But beyond this, the book is enlivened throughout with perceptive remarks on the contemporary social habits and preoccupations which influenced the rise and fall of the fern craze. It is unusual to find a social historian writing a book on a natural history subject, but this is what we have here. Indeed, this is such a well-written and attractive study that one can only hope that Mr. Allen will explore other fields in what the publisher's blurb refers to as the "cultural no-man's land . . . between the history of taste and the history of science."

The plentiful illustrations are all taken from Victorian publications, and their somewhat monotonous sameness is no doubt intentional. The general format of the book is pleasing, and I noticed only a single misprint, "cryptograms" instead of "cryptogams" on page 66. The Appendix of "new words brought into use by the fern craze", with dates of their first recorded use, is interesting, though it seems doubtful whether unhyphened combinations such as "fern collector" merit inclusion.

R. M. Payne

A Key to the British Fresh- and Brackish-water Gastropods, by T. T. Macan, third edition. 47 pages + 15 text figs. Freshwater Biological Association, Scientific Publication No. 13, 1969. 4s. 6d.

The first edition of this key was enthusiastically reviewed in 1949 in the *London Naturalist.* It was then the only work in print on the subject, but now the aspiring conchologist can choose from several illustrated works on the British Land and Fresh-water Molluscs.

However, none of them approaches this key in value for money and in the excellent illustrations of every species found in such habitats. The only really unsatisfactory figure is that of *Valvata cristata* which is operculate and has a circular aperture; the specimen drawn shows neither of these characters, and if not a *Planorbis*, is most abnormal and misleading.

The nomenclature has been brought up to date. There are "Notes on Ecology", with special reference to the Lake District and a short bibliography.

C. P. Castell

A Short History of the Brown-tail Moth, 1782, by William Curtis. A Facsimile reproduction, 13 + xvii and Plate. Curwen, 1969. 4vo. £3 15s. 0d.

This historic and in fact quite classic short review of the Brown-tail Moth was produced by that eminent early authority on Entomology, William Curtis almost 200 years ago. It is remarkable, when one reads his very precise Treatise on the life history of this insect and the devastation caused by hosts of larvae in the vicinity of London, how advanced the observers of Natural History were already in those somewhat bygone days. His coloured plate, too, of the moth and its earlier stages could hardly be improved upon even in these enlightened times. It is as a whole an excellent sample of precision in observation and deduction with effective recommendations how to cope with the current pest.

It therefore seems very fitting that this possibly unique account of one particular species of our lepidoptera in the late 18th century should be reproduced in such a very fine facsimile form on the original type of paper. Naturally some explanation of the work and its author should be included and to this end the first 12 pages are devoted to a most scholarly and erudite study of the life of William Curtis by Dr. William T. Stearn of the Botany Department of the British Museum (Natural History). Dr. Stearn has indeed given a most concise account of this most colourful entomologist and above all botanist, whose great contribution to science was his "Flora Londinensis" (1775-1798) at a time when the Fritillary flower could be found in meadows at Mortlake and cotton-grass growing in the Battersea marshes. It was the sudden appearance of these larvae devouring all vegetation in their wake in and around London that prompted Curtis in 1782 to produce this memorable short paper. It is fortunate that the Brown-tail seems now confined to purely seaboard localities from Suffolk to the Isle of Wight as pointed out by D. S. Fletcher, also of the Natural History Museum, in another very interesting survey of the occurrence and present distribution of this insect both in this country and elsewhere, especially the United States where it has become a very costly pest in the eastern region since it was accidentally brought in there late in the last century. Both introductions have very useful lists of literature appended. The thin volume is attractively bound and what with the good quality of the paper the price of 75s. does not seem excessive.

C.G.M. de Worms

The Growth of Natural History in Stuart England from Gerard to the Royal Society, by F. D. and J. F. M. Hoeniger. (Folger Booklets on Tudor and Stuart Civilization.) 54 pages + 19 plates. University Press of Virginia, Charlottesville; Oxford University Press, London. Published for the Folger Shakespeare Library, August 1969. 10s.

This interesting little booklet forms the second of two dealing with the change in man's approach to nature which took place between about 1500 and 1700. The present booklet picks up the story with the publication of Gerard's Herbal in 1597.

The name of the author of this work, John Gerard, is probably associated with English herbals to the exclusion of most others to the naturalist who does not specialise in botany. The authors say that "a rogue's accomplishments often make a better story than an honest man's", and certainly Gerard had his "seamy" side to the extent that he was inventive when the facts were not readily available.

Many other famous—and more reliable—works are quoted and pleasing thumb-nail sketches of some of the scientific "classics" are given.

Within the limits of the title—dealing only with natural history—the book forms an excellent introduction to anyone interested in this fascinating period, and a section dealing with suggested reading will be invaluable.

Many of the plates are familiar from works of the period, and some of them must always command admiration for the skill of the men who used, so skilfully, the comparatively primitive instruments of their day.

Perhaps seeming expensive at 10s. (probably because of its American origin) it is nevertheless good value.

R. C. VERNON

Nature Conservation in Britain, by Sir Dudley Stamp. 273 pages with extensive bibliography and four appendices. Collins New Naturalist series, 1969. 36s.

This was Sir Dudley Stamp's last book—he died before it could be published—and as both geography and nature conservation owe so much to him, it is indeed a fitting memorial in this European Conservation Year. He aimed to give "A snap-shot picture of the present stage of progress," and this he does, producing a general background to the conservation movement and its history, with chapters on the Nature Conservancy, the Trusts, and other bodies. Each part of the British Isles is discussed extensively with reference to the special characteristics of its reserves, and these are sections which would be well worth reading prior to visiting any part of the country unknown to one. There is an extensive list of centres suitable for field studies, and the appendices are particularly useful for here are listed the names and addresses of County Trusts, reserves, national parks, and naturalists organisations. There are chapters on such controversial subjects as the problem of introductions, reserve management and control, the work of zoos, the law and the land, plus the effect of modern farming and forestry on conservation.

Throughout the book, Sir Dudley views nature conservation as part of the world-wide problem of resource conservation and points out that whereas the attempt to protect animals and plants by legislation was formerly regarded as the work of a few rather eccentric sentimentalists merely anxious to preserve the countryside as it was in their youth—a wrong view of conservation—man's care for his natural environment is now regarded as an essential concern of civilized society.

For anyone who found Dr. Fraser Darling's recent Reith lectures absorbing, this book is a "must". Others not so interested in these vital problems of our times would do well to glance at this book; as always Sir Dudley Stamp's lucid prose is a delight.

D. C. Hersey

The Library

Recent additions to the library include:—

Barnes, H. F. *Gall Midges of Economic Importance.* Vol. 8. 1969.
Brown, G. M. and others. Geologists' Association Guide: *The Tertiary Igneous Geology of the Isle of Skye.* 1969.
Clarke, H. *Bird Watching.* 1968.
Condry, W. M. *The Snowdonia National Park.* 1966.
Cornwell, P. B. *The Cockroach.* 1968.
Davies, L. *A Key to the British Species of Simuliidae* (Diptera). 1968.
Eckert, A. W. *Wild Season.* 1968.
Hynes, H. B. N. *A Key to the Adults and Nymphs of British Stoneflies* (Plecoptera). 1967.
Ing, B. *A Census Catalogue of Myxomycetes.* 1968.
Kirkaldy, J. F. *Fossils in Colour.* 1967.
Kirkaldy, J. F. *Minerals and Rocks in Colour.* 1968.
Moore, I. *Grass and Grasslands.* 1966.
Peigler, D. N. *The Polyporaceae.* 1968.
Petch, D. N. and Swann, E. L. *Flora of Norfolk.* 1968.
Polunin, O. *Flowers of Europe.* 1969.
Skelhorn, R. R. and others. Geologists' Association Guide: *The Tertiary Igneous Geology of the Isle of Mull.* 1969.

Since the library has been at Ealing, a considerable collection of Ray Society publications has been built up. The Administration and Finance Committee has given permission for this run to be completed if and when further volumes become available. Nine more parts were added this year.

Statement of Affairs

1968				1969					
£	s.	d.		£	s.	d.	£	s.	d.
			The Hindson Bequest						
—	—	—	Amounts received from the Executors of the Estate during the year	14,000	0	0			
—	—	—	*Add:* Interest received on Investments during the year	224	8	8			
							14,224	8	8
			Accumulated Fund						
(75	*2*	*9*	Balance at 1st November, 1968	(deficit)			(75	2	9)
			Premises Fund						
1,802	*0*	*0*	Balance at November 1, 1968	1,910	0	0			
108	*0*	*0*	*Add:* Interest for the year	124	3	0			
1,910	*0*	*0*		2,034	3	0			
			Less: Transfer to General Account	68	18	3			
£1,910	*0*	*0*					1,965	4	9
			Life Composition Account						
400	*0*	*0*	Balance at November 1, 1968	400	0	0			
—	—	—	*Less:* Transfer to General Account	100	0	0			
£400	*0*	*0*					300	0	0
			Library Cataloguing Fund						
£200	*0*	*0*	Balance at November 1, 1968				200	0	0
			Castell Research Centre Fund (Carnegie Scheme)						
50	*0*	*0*	Balance at November 1, 1968	125	0	0			
75	*0*	*0*	*Add:* Transfer from General Account	75	0	0			
£125	*0*	*0*					200	0	0
			Ornithological Research Fund						
204	*5*	*11*	Balance at November 1, 1968	173	9	2			
5	*4*	*0*	*Add:* Royalties received in year	3	12	6			
13	*19*	*3*	Interest received in year	12	10	3			
223	*9*	*2*		189	11	11			
50	*0*	*0*	*Less:* Grant to Atlas Scheme	—	—	—			
£173	*9*	*2*					189	11	11
			Other Reserves						
550	*0*	*0*	*London Bird Report* No. 33 Reserve	550	0	0			
75	*0*	*0*	Plant Mapping Scheme Publication	75	0	0			
41	*8*	*4*	*London Naturalist* No. 48 Reprints	50	0	0			
—	—	—	Hire of Halls	100	0	0			
—	—	—	European Conservation Year	50	0	0			
50	*0*	*0*	Printing of Rules	—	—	—			
£716	8	4					825	0	0
£3,449	*14*	*9*					£17,829	2	7

at 31st October, 1969

1968 £	s.	d.		1969 £	s.	d.	£	s.	d.
			The Hindson Bequest Investments						
—	—	—	Quoted Investments, at cost	10,000	0	0			
—	—	—	Bank Deposit Account...	4,224	8	8			
							14,224	8	8
			General Fund Investments						
229	*4*	*6*	Quoted Investments, at cost	154	4	6			
			Current Assets						
			Balance at Bank:						
72	*9*	*1*	Current Account	331	6	2			
748	*9*	*2*	Deposit Account	564	11	11			
2,399	*12*	*0*	Deposit with Central Investment Company... ...	2,554	11	4			
							3,450	9	5
£3,220	*10*	*3*							

Audited and found correct,
November 18, 1969.

A. J. BARRETT, *Hon. Treasurer.*
R. W. HALE, *Hon. Auditor.*
H. B. CAMPLIN, *Hon. Auditor.*

GENERAL

1968 £	s.	d.	*Payments*	1968 £	s.	d.
241	*3*	*6*	Hire of Halls	148	1	11
107	*8*	*1*	Sectional Expenses	117	9	4
42	*6*	*6*	Subscriptions to other Societies	32	16	6
101	*19*	*5*	Printing and Stationery	84	14	10
26	*2*	*4*	Library Expenses	112	8	4
9	*6*	*9*	Castell Research Centre	31	2	9
6	*0*	*0*	L.N.C.C....	32	13	0
200	*0*	*0*	Honoraria	137	10	0
	16	*6*	Covenant Expenses		3	9
12	*3*	*1*	Telephone	2	13	6
61	*5*	*3*	Postages ...	120	13	10
42	*11*	*6*	Sundries ...	46	16	7
	9	*8*	Bird Film Payment	—	—	—
15	*8*	*0*	Purchase of Wooden Cabinet ...	—	—	—
16	*9*	*0*	Calling of Special General Meeting ...	—	—	—
13	*17*	*0*	Refund of subscriptions credited in error by Bank ...	—	—	—
1,407	*16*	*5*	Grant to Publications Account	1,820	13	1
—	—	—	European Conservation Year Grant ...	50	0	0
—	—	—	Purchase, Removal and Overhaul Duplicator	159	9	0
—	—	—	Loss from Sale of securities (£75—£28 14s. 5d.)	46	5	7
2,305	*3*	*0*		2,943	12	0
			Transfers to Reserves:			
75	*0*	*0*	Carnegie Scheme	75	0	0
—	—	—	Hire of Halls	100	0	0
75	*0*	*0*	Plant Mapping Scheme Research and Publication	—	—	—
50	*0*	*0*	Printing Rules	—	—	—
—	—	—	European Conservation Year	50	0	0
£2,505	*3*	*0*		£3,168	12	0

PUBLICATIONS

261	*9*	*6*	Programme	251	18	2
41	*8*	*4*	*London Naturalist Reserve* for Reprints	50	0	0
590	*19*	*10*	*London Naturalist* No. 48	1,020	11	10
550	*0*	*0*	*London Bird Report* No. 33 Reserve ...	550	0	0
41	*6*	*0*	Addressing and Wrapping	45	14	6
98	*0*	*6*	Postages ...	104	5	9
£1,583	*4*	*2*		£2,022	10	3

ACCOUNT

1968 £	s.	d.	*Receipts*	£	s.	d.	1969 £	s.	d.
2,056	*7*	*7*	Subscriptions Current	2,561	12	0			
8	*5*	*0*	Subscriptions Arrears	—	—	—			
97	*0*	*0*	Subscriptions Advance...	62	5	0			
53	*10*	*0*	Entrance Fees	32	10	0			
2,215	*2*	*7*					2,656	7	0
18	*11*	*6*	Donations				60	7	11
99	*6*	*11*	Tax recovered from Deeds of Covenant				135	10	7
8	*0*	*6*	Interest on Investments				8	0	6
44	*7*	*11*	Westminster Bank Deposit Account Interest				53	6	5
27	*15*	*10*	Central Inst. Co. Interest on Reserves (excluding Premises Account)				30	16	4
22	*10*	*6*	Bird Film Receipts				5	5	0
3	*3*	*8*	Sundries				—	—	—
—	—	—	Transfer from Printing Rules Reserve				50	0	0
—	—	—	Transfer from Life Composition Fund				100	0	0
—	—	—	Transfer from Premises Fund...				68	18	3
66	*3*	*7*	Excess of payments over receipts				—	—	—
£2,505	*3*	*0*					£3,168	12	0

ACCOUNT

£	s.	d.		£	s.	d.
125	*15*	*0*	Sale of Publications	141	9	11
20	*19*	*0*	Advertisements and Sale of Mailing Lists	27	10	0
—	—	—	*London Naturalist* No. 47 Reprint Reserve	—	—	—
28	*13*	*9*	*London Bird Report* No. 32 Reserve (£550—£549.12.9)		7	3
1,407	*16*	*5*	Transfer from General Account	1,820	13	1
—	—	—	Donation towards printing cost of *London Naturalist*	32	10	0
£1,583	*4*	*2*		£2,022	10	3

MUSEUM
2 0 OCT 1970
NATURAL HIST

INSTRUCTIONS FOR CONTRIBUTORS

Contributors are asked to study these notes with care, to save themselves and the Editor unnecessary work in the revision of manuscripts.

DATE OF SUBMISSION OF PAPERS

Papers should be submitted to the Editor (address in Programme) by the end of January and not later than the middle of February if they are to be considered for publication in the same year.

TEXT

Papers and short notes should be submitted in final fully corrected form. They should be typed, with double spacing and a wide margin, on one side of the paper only. Submission in duplicate is requested if possible, and authors are advised to retain a second copy for their own reference purposes. The total number of words should be pencilled at the head of the paper.

FOOTNOTES

Footnotes should be avoided wherever possible, but may be used for brief notes which cannot be fitted conveniently into the text. They should be inserted in the typescript immediately below the line to which they refer.

SCIENTIFIC NAMES

Scientific names should be underlined, and the authority upon which they are based should be cited. Where English names of species are employed, it is suggested that a capital letter be used for the beginning of the name, e.g. Badger.

REFERENCES

References should be listed at the end of the paper, in alphabetica order of authors' names, in the following standard form:

MATTHEWS, L. HARRISON (1952). *British Mammals.* London.

YOUNG, G. W. (1905). The Chalk Area of North-East Surrey. *Proc. Geol. Assoc.*, **19**, 196-206.

The corresponding references in the text would be (Matthews, 1952) and (Young, 1905).

As far as possible, titles of journals should be abbreviated according to the latest (4th) edition of the *World List of Scientific Periodicals.* Authors who require guidance on this point should consult the Editor.

DATES

These should be in the form June 9, 1964.

ILLUSTRATIONS

Distribution maps of plants and animals within the Society's recording area, and using either the tetrad or the monad system of grid recording, should be submitted in the form of a Recording Map with symbols in Indian ink or with black self-adhesive symbols. Solid dots are to be used to indicate contemporary or recent presence, circles for old records and crosses (not pluses) for other information, such as introduced species.

Tetrad dots and circles should be 4·0 mm (0·16 ins) and tetrad crosses should be 5·0 mm (0·20 ins), with a line thickness of 0·8 mm (0·03 ins); all monad symbols should be 1·6 mm (0·06 ins) with a line thickness of 0·5 mm (0·02 ins). Title, legend, etc., should be written outside the frame of the map and will be set up by the printer.

Mapping Schemes Secretary can provide Recording Maps and advise on methods of drawing the symbols.

Line drawings should be submitted separately, in Indian ink on thick white paper or card, preferably 2x or 3x the size finally intended. Graphs should be drawn on paper preferably ruled in blue or faint grey. Legends should be typed separately, as they will be set up by the printer. The use of stencils or self-adhesive lettering is strongly recommended for place-names etc. on maps.

The Editor should be consulted in good time if there is any doubt about the preparation of illustrations. Photographs can be accepted only after prior consultation.

PROOFS

Galley proofs will be sent to authors for scrutiny, but only essential corrections can be made at that stage.

OFFPRINTS

Up to 25 free offprints will be supplied on request. Additional copies may be purchased if an order is made when the proofs are returned.

Note : The opinions expressed in papers and reviews published in the *London Naturalist* are those of the Authors, and not necessarily those of the Society.